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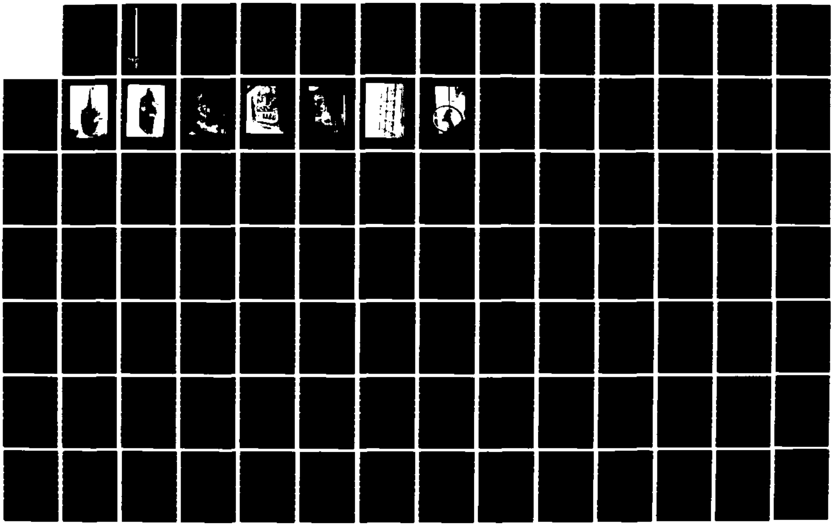

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Report 2375

BASELINE AND VERIFICATION TESTS OF THE ELECTRIC VEHICLE ASSOCIATES' CURRENT FARE STATION WAGON

by

Edward J. Dowgiallo, Jr.

and

Robert D. Chapman

January 1983

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U.S. ARMY MOBILITY EQUIPMENT
RESEARCH AND DEVELOPMENT COMMAND
FORT BELVOIR, VIRGINIA

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The EVA Current Fare Station Wagon, an electric vehicle, was tested at MERADCOM as part of a Department of Energy project to characterize the state-of-the-art of electric vehicles. The current Fare Wagon was manufactured in Cleveland, Ohio by Electric Vehicle Associates' Incorporated. It is powered by 22 6-V lead-acid batteries driving a 30-hp d.c. series motor through an SCR controller. The motor drives the rear wheels through a manually operated 4-speed transmission. Regenerative braking was provided.

PREFACE

The electric and hybrid vehicle test was conducted by the U.S. Army Mobility Equipment Research and Development Command (MERADCOM) under the guidance of the U.S. Department of Energy (DOE).

Michael E. Johnson, Project Engineer, of VSE Corporation, was responsible for aspects of calibration of the signal conditioning circuits and recording instruments and for tabulations and plotting of the data in this report.

Computer programming and data tabulation and analysis were performed by Arthur Nickless of the Systems Technology and Management Division, Management Information Systems Directorate, MERADCOM.

Aubrey Thomas and James A. Queen of the Environmental and Field Division, Product Assurance and Testing Directorate, MERADCOM, assisted in vehicle operation and data collection.

The report was prepared to document work sponsored by the United States Government. Neither the United States nor its agent, the United States Army, nor any Federal employees, nor any of their contractors, sub-contractors, or their employees, makes any warranty, express or implied, or assumes any legal liability to responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights.

The view, opinion, and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy, or decision unless so designated by other documentation. The purpose of this report is to make available data and information on an electric vehicle. The tasks of drawing conclusions and making recommendations based on this report is reserved by and for the U.S. Department of Energy. This vehicle was tested to determine its conformity to the Department of Energy "Performance Standards for Demonstrations." The results reported herein show the nominal capability of the vehicle when it failed to meet the standards. The vehicle may exceed the performance reported herein in actual use. It also may have safety features and amenities not required by the Department of Energy Standards.

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BASELINE AND VERIFICATION TESTS OF THE ELECTRIC VEHICLE ASSOCIATES' CURRENT FARE STATION WAGON

I. SUMMARY

The EVA Current Fare Wagon was manufactured by Electric Vehicle Associates, Incorporated (EVA) of Cleveland, Ohio. It is now available from Lectra Motors Corp. of Las Vegas, Nevada. The vehicle was tested under the direction of MERADCOM from 27 March 1980 to 6 November 1981. The tests are part of a Department of Energy project to assess advances in electric vehicle design. This report presents the performance test results on the EVA Current Fare Wagon.

The EVA Current Fare Wagon is a 1980 Ford Fairmont station wagon which has been converted to an electric vehicle. The propulsion system is made up of a Cableform controller, a series-wound 30-hp Reliance Electric Motor, and 22 6-V lead-acid batteries. The Current Fare Wagon is also equipped with regenerative braking. Further details of the vehicle are given in the Vehicle Summary Data Sheet, Appendix A. The results of this testing are given in Table 1.

II. INTRODUCTION

The vehicle tested and the data presented in this report are in support of Public Law 94-413, enacted by Congress on 17 September 1976. The law requires the Department of Energy to develop data characterizing the state-of-the-art with respect to electric and hybrid vehicles. The data so developed are to serve as a baseline to compare improvement in electric and hybrid vehicle technologies, to assist in establishing performance standards for electric and hybrid vehicles, and to help guide future research and development activities.

MERADCOM, under the direction of the Electric and Hybrid Vehicles Division, Office of Vehicle and Engine Research and Development DOE, has conducted track tests of electric vehicles to measure their performance characteristics and vehicle component efficiencies.

The tests were conducted using a DOE test procedure "ERDA-EHV-TEP," described in Appendix A of MERADCOM Report 2244.[1] This procedure uses the "Electric Vehicle Test Procedures SAE J227a," revised February 1976. U.S. customary units were used in the collection and reduction of data and are shown in Table 2. The units were converted to the International System of Units for presentation in this report. U.S. customary units are presented in parentheses. Number values are truncated to reflect nominal values except where precision is required.

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[1] "BASELINE TESTS OF THE EVA METRO ELECTRIC PASSENGER VEHICLE," MERADCOM Report 2244 (May 1978).

TABLE 1. EVA CURRENT FARE WAGON TEST RESULTS
(Metric Units)

DATE	TYPE TEST	GEARS USED	DIST (km)	CYCLES	NET BATTERY ENERGY D.C. (kWh)	CHARGE ENERGY A.C. (kWh)	VEHICLE ENERGY ECONOMY (kWh/km)	BATTERY TEMPERATURE RANGE START (°C)	BATTERY TEMPERATURE RANGE END (°C)	WEATHER COND. START OF TEST TIME	WEATHER COND. START OF TEST WIND SPEED (km/h)	WEATHER COND. START OF TEST TEMPERATURE (°C)	WEATHER COND. END OF TEST TIME	WEATHER COND. END OF TEST WIND SPEED (km/h)	WEATHER COND. END OF TEST TEMPERATURE (°C)
11 Jun 81	C cycle	1,2 3	74.3	129		35.6	.479	28-32	45-53	1000	8	22	1300	8	24
15 Jun 81	56.3 km/h	1,2,3	94.1			30.9	.328	24-25	41-45	0850	calm	26	1045	calm	28
16 Jun 81	56.3 km/h	1,2,3	101.3			31.6	.311	29-33	45-51	0730	calm	25	0920	5	28
18 Jun 81	B cycle	1,2	85.5	255		34.9	.408	24-25	38-46	0735	calm	20	1305	calm	27
23 Jun 81	72.4 km/h	1,2,3,4	73			35.8	.489	25	41-48	1255	8	27	1405	8	28
26 Jun 81	56.3 km/h	1,2,3	93.3			30.1	.322	28	41-43	0700	8	19	0850	8	21
29 Jun 81	B cycle	1,2	83.9	250		33.7	.401	22-23	40-48	0810	calm	20	1325	calm	33
2 Jul 81	40.2 km/h	1,2	119.5			34.7	.290	25-26	36-42	0730	calm	22	1030	calm	25
6 Jul 81	40.2 km/h	1,2	115.8			35.0	.302	22-24	36-43	0835	calm	22	1130	calm	25
7 Jul 81	72.4 km/h	1,2,3	91.7			32.5	.354	32-35	43-51	0815	6.4	24	0932	6.4	24
8 Jul 81	72.4 km/h	1,2,3	88.0			31.4	.356	32-33	41-47	0730	3.2	25	0845	3.2	28
10 Jul 81	C cycle	1,2 3	76.2	140		44.7	.586*	34-37	48-53	0745	calm	27	1050	calm	28
23 Jul 81	D cycle	1,2,3,4	62.4	38		29.5	.472	29-32	33-41	0835	calm	24	1000	calm	25
24 Jul 81	D cycle	1,2,3,4	64.0	39		44.0	.687*	26-29	35-36	0807	calm	23	0938	calm	24
11 Aug 81	B cycle	1,2	79.8	245		34.4	.431	32	43-51	0645	3.2	25	1155	3.2	30
18 Aug 81	B cycle	1,2	79.4	248		35.2	.442	24	36-46	0745	1.6	20	1255	1.6	25
20 Aug 81	B cycle	1,2	78.0	244		34.6	.443	23-25	36-47	0745	3.2	19	1245	8	29
26 Aug 81	B cycle	1,2	84.8	264		35.1	.414	27-28	39-49	0750	calm	17	1300	8	27
28 Aug 81	B cycle	1,2	85.6	271	24.7	36.2	.427	29-30	42-52	0800	calm	20	1300	calm	35
31 Aug 81	C cycle	1,2,3	73.4	130	21.8	33.2	.452	30-33	44-59	0745	calm	22	1110	calm	24
1 Sep 81	C cycle	1,2,3	73.4	130		33.4	.455	30-34	45-62	0745	calm	21	1055	calm	23
3 Sep 81	D cycle	1,2,3,4	67.2	42	17.8	33.5	.498	31-34	35-46	0915	calm	20	1045	calm	21
10 Sep 81	40.2 km/h	1,2	107.8		29.7	32.5	.301	20	33-44	0815	calm	20	1130	calm	23
14 Sep 81	56.3 km/h	1,2,3	97.8		22.8	32.3	.330	25	38-53	0745	calm	16	0922	calm	22
15 Sep 81	72.4 km/h	1,2,3	86.0		21.6	29.3	.340	33-36	43-53	0745	calm	21	0900	calm	22

*Vehicle on charge over weekend.

TABLE 2. EVA CURRENT FARE WAGON TEST RESULTS
(U.S. Customary Units)

DATE	TYPE TEST	GEARS USED	DIST (mi)	CYCLES	NET BATTERY ENERGY D.C. (kWh)	CHARGE ENERGY A.C. (kWh)	VEHICLE ENERGY ECONOMY (kWh/mi)	BATTERY TEMPERATURE RANGE START (°F)	BATTERY TEMPERATURE RANGE END (°F)	WEATHER COND. START OF TEST TIME	WEATHER COND. START OF TEST WIND SPEED (mi/h)	WEATHER COND. START OF TEST TEMPERATURE (°F)	WEATHER COND. END OF TEST TIME	WEATHER COND. END OF TEST WIND SPEED (mi/h)	WEATHER COND. END OF TEST TEMPERATURE (°F)
11 Jun 81	C cycle	1,2 3	46.2	129		35.6	.770	83-90	113-128	1000	5	72	1300	5	75
15 Jun 81	35 mi/h	1,2,3	58.5			30.9	.528	76-78	106-112	0850	calm	79	1045	calm	82
16 Jun 81	35 mi/h	1,2,3	63.0			31.6	.501	85-92	113-129	0730	calm	78	0920	3	83
18 Jun 81	B cycle	1,2	53.2	255		34.9	.656	75-78	101-115	0735	calm	68	1305	calm	80
23 Jun 81	45 mi/h	1,2,3,4	45.5			35.8	.787	74-75	106-118	1255	5	80	1405	5	83
26 Jun 81	35 mi/h	1,2,3	58.0			30.1	.519	82	106-109	0700	5	66	0850	5	70
29 Jun 81	B cycle	1,2	52.2	250		33.7	.645	71-73	104-118	0810	calm	68	1325	calm	92
2 Jul 81	25 mi/h	1,2	74.3			34.7	.467	78-79	97-108	0730	calm	71	1030	calm	78
6 Jul 81	25 mi/h	1,2	72.0			35.0	.486	72-76	97-110	0835	calm	72	1130	calm	78
7 Jul 81	45 mi/h	1,2,3	57.0			32.5	.570	90-96	110-125	0815	4	75	0932	4	76
8 Jul 81	45 mi/h	1,2,3	54.7			31.4	.574	89-92	106-116	0730	2	78	0845	2	83
10 Jul 81	C cycle	1,2 3	47.4	140		44.7	.943*	93-98	119-128	0745	calm	80	1050	calm	83
23 Jul 81	D cycle	1,2,3,4	38.8	38		29.5	.760	85-91	92-106	0835	calm	76	1000	calm	78
24 Jul 81	D cycle	1,2,3,4	39.8	39		44.0	1.105*	79-85	95-96	0807	calm	74	0938	calm	76
11 Aug 81	B cycle	1,2	49.6	245		34.4	.693	90-91	110-124	0645	2	78	1155	2	86
18 Aug 81	B cycle	1,2	49.4	248		35.2	.712	75	98-115	0745	1	68	1255	1	78
20 Aug 81	B cycle	1,2	48.5	244		34.6	.713	74-77	97-117	0745	2	66	1245	5	85
26 Aug 81	B cycle	1,2	52.7	264		35.1	.666	81-83	103-121	0750	calm	63	1300	5	80
28 Aug 81	B cycle	1,2	53.2	271	24.7	36.2	.680	85-87	108-127	0800	calm	68	1300	calm	96
31 Aug 81	C cycle	1,2,3	45.6	130	21.8	33.2	.728	87-91	111-138	0745	calm	72	1110	calm	76
1 Sep 81	C cycle	1,2,3	45.6	130		33.4	.732	87-94	113-145	0745	calm	70	1055	calm	74
3 Sep 81	D cycle	1,2,3,4	41.8	42	17.8	33.5	.801	88-93	95-115	0915	calm	68	1045	calm	70
10 Sep 81	25 mi/h	1,2	67.0		29.7	32.5	.485	69	91-111	0815	calm	69	1130	calm	74
14 Sep 81	35 mi/h	1,2,3	60.8		22.8	32.3	.531	77-78	101-128	0745	calm	62	0922	calm	72
15 Sep 81	45 mi/h	1,2,3	53.5		21.6	29.3	.547	92-98	110-127	0745	calm	70	0900	calm	72

*Vehicle on charge over weekend.

III. OBJECTIVES

The characteristics of interest for the EVA Curent Fare Wagon electric vehicle are: range at constant speed, range when operated in a selected driving mode, maximum acceleration, gradeability limit, road energy, road power, and vehicle energy economy.

IV. TEST VEHICLE DESCRIPTION

a. Description. The EVA Current Fare Wagon is a standard Ford Fairmont station wagon which has been converted to an electric vehicle (Figures 1 and 2). It is powered by 22 6-V lead-acid batteries[2] connected in series. The batteries are configured in two sections, one under the hood of the vehicle (Figures 3 and 4) and the other in what was the rear luggage compartment (Figures 5 and 6). Both battery packs are ventilated during operation and charging of the vehicle.

The Current Fare Wagon has two full-sized front passenger seats and one bench-type rear seat and can easily accommodate four people. The interior is upholstered in blue vinyl plastic. The vehicle has the standard instrumentation found in an internal combustion engine auto: speedometer, odometer, windshield wipers, etc. It also contains a complement of electric vehicle instrumentation consisting of: a d.c. digital voltmeter which shows traction battery voltage and auxiliary battery voltage, a d.c. ammeter which indicates traction battery current, and a motor temperature overheat gauge (Figure 7). Other data on vehicle equipment and features are given in Appendix A.

b. Operating Characteristics. The Current Fare Wagon has a standard accelerator, brake, clutch, steering configuration, and a manual four-speed transmission. It is powered from the traction battery pack through a Pulsomatic Mark 10 SCR controller by Cableform, to a 30-hp series-wound d.c. motor. It also has a 12-V auxiliary battery to power the accessories.

V. INSTRUMENTATION

The Current Fare Wagon was instrumented with a Labeco fifth wheel to provide accurate speed and range information. The traction battery voltage and current were monitored and preconditioned for the recorder. These data were electronically mulitplied to give an instantaneous power and then were averaged. Other averaged outputs are the average traction battery voltage, average current, and average power. An Ohio Semitronics Hall Effect Watt-

[2] See Section IX and Appendix A.

Figure 1. Front ¾-view current fare wagon.

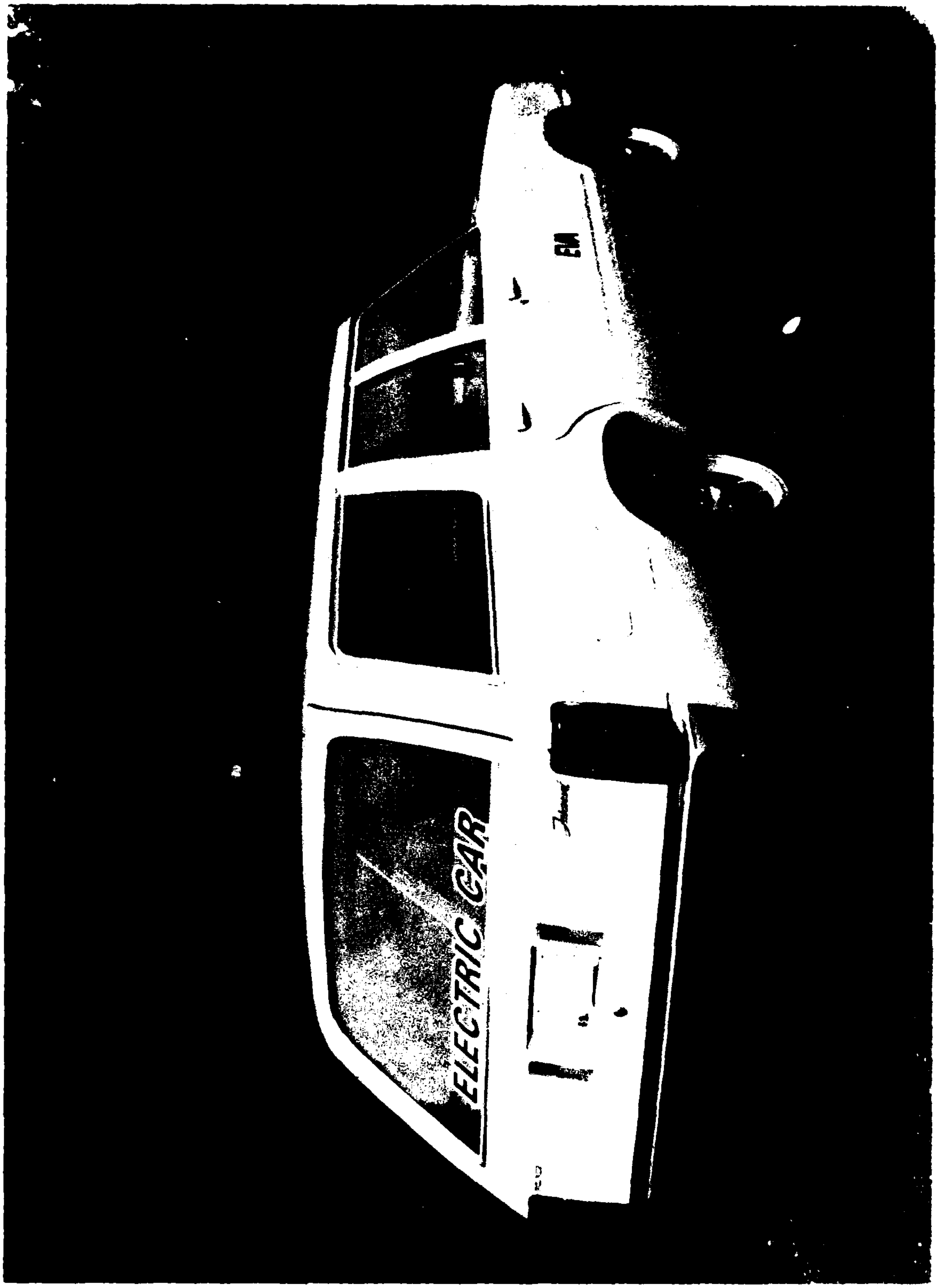


Figure 2. Rear ¾-view current fare wagon.

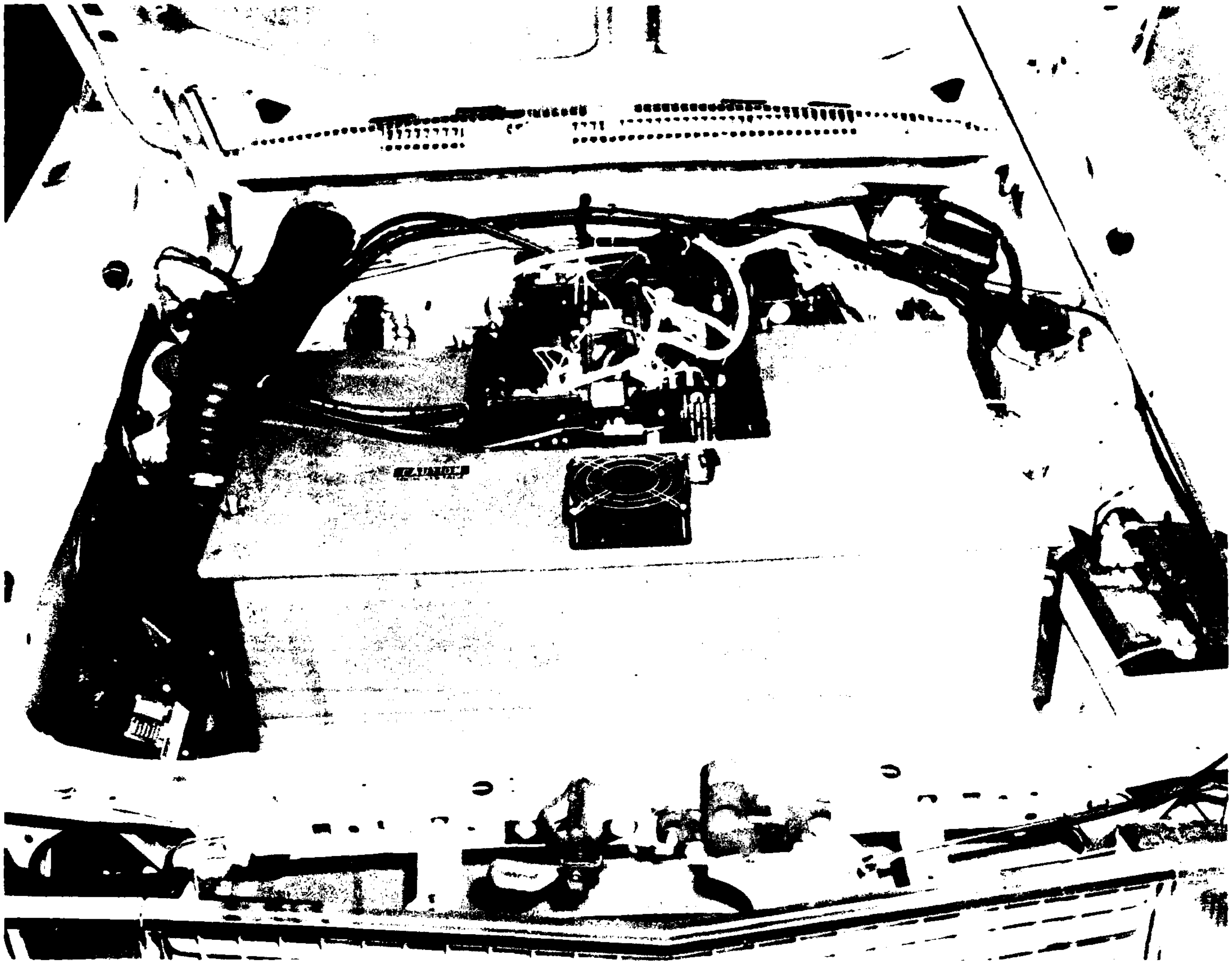


Figure 3. Front battery pack (covered).

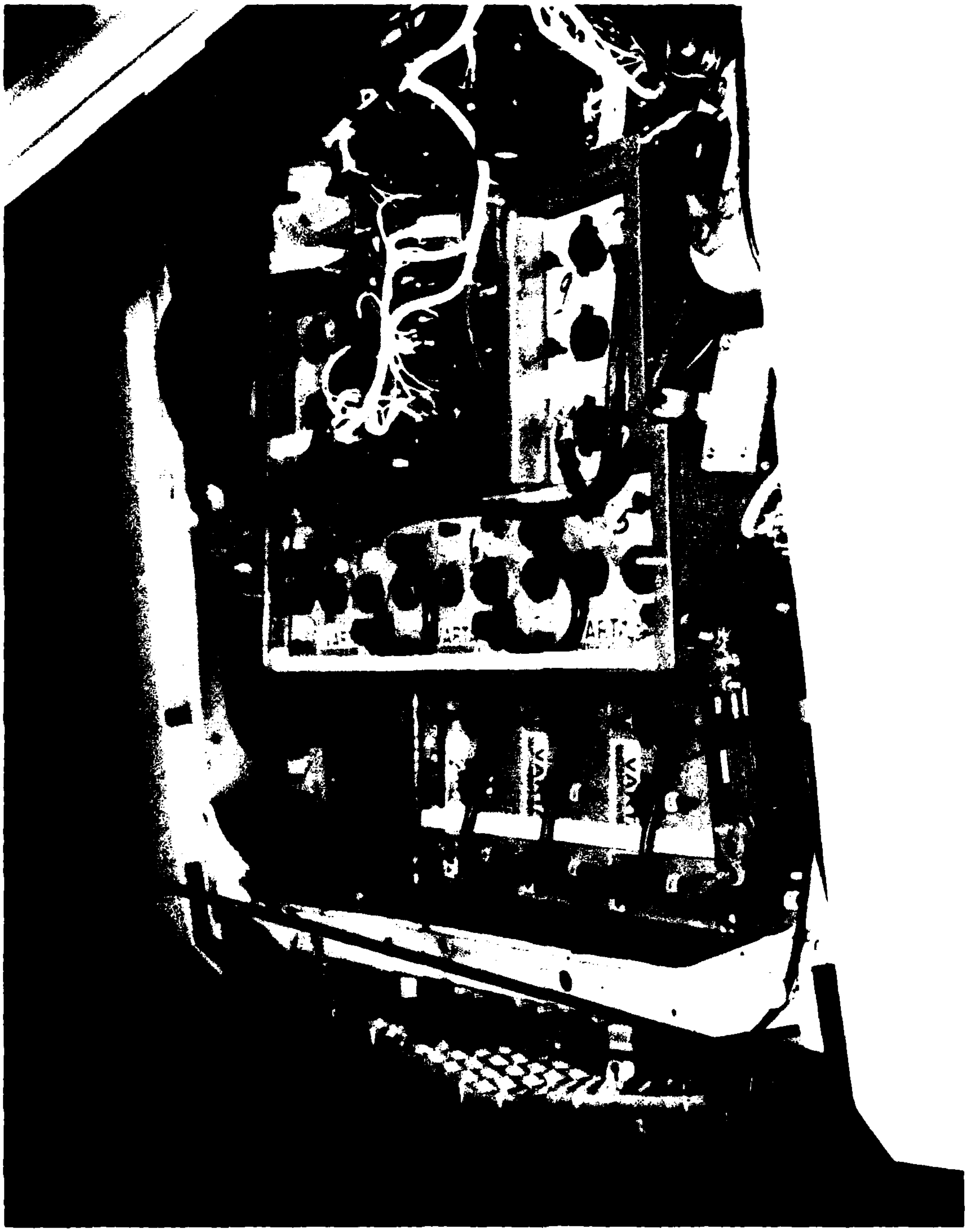


Figure 4. Front battery pack (open).

Figure 5. Rear battery pack (covered).

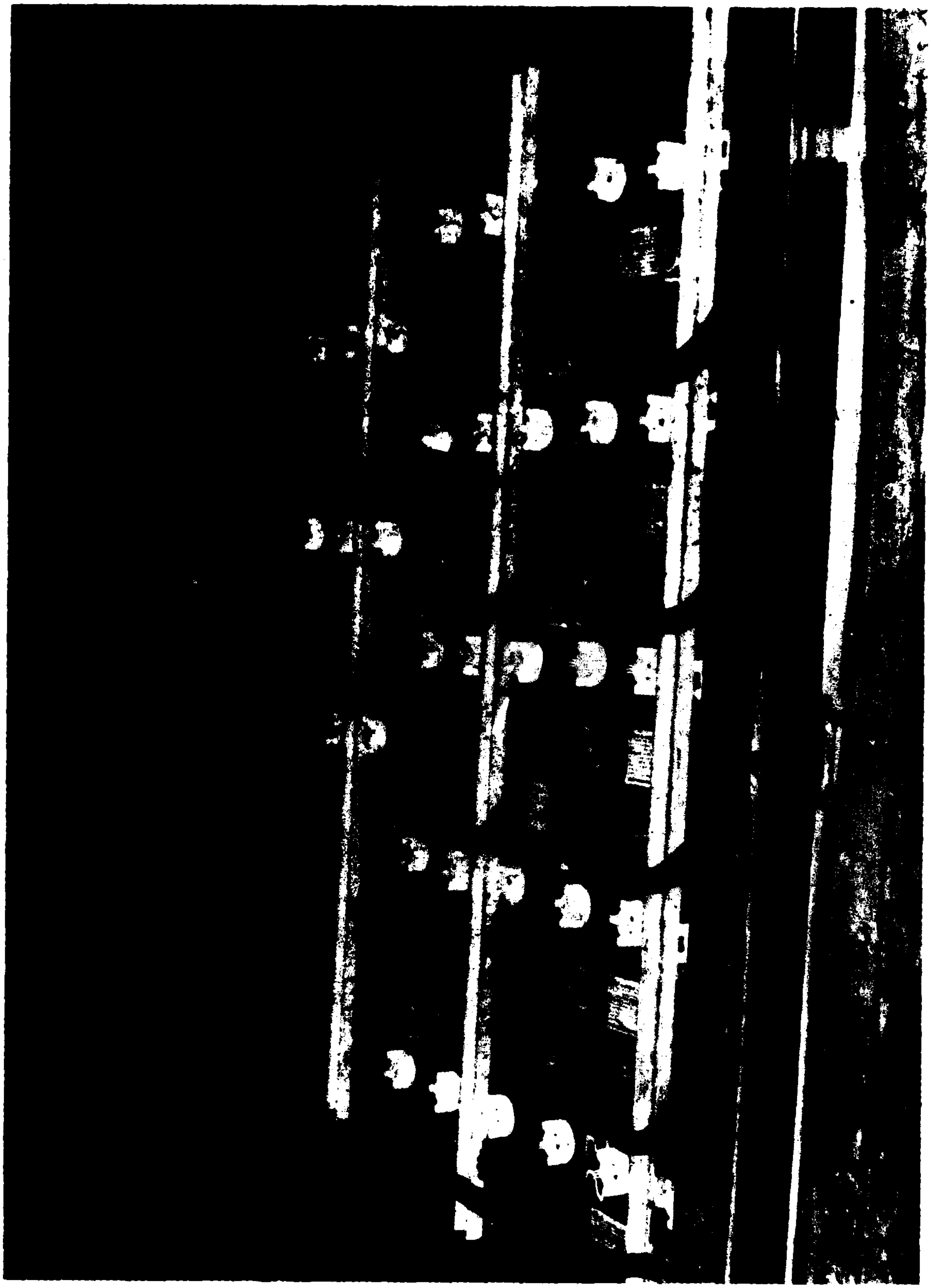


Figure 6. Rear battery pack (open).

Figure 7. Instrument panel.

hour meter was also used to provide a concurrent reading of traction system power and energy during tests and during recharge of the traction battery. These data were recorded on a Lockheed Store 7 F.M. recorder. Details of the recorder are given in Appendix D of MERADCOM Report 2244.

VI. TEST PROCEDURES

The tests were performed at the MERADCOM test facility at Fort Belvoir and at the Aberdeen Proving Ground (APG) test facility at Aberdeen, Maryland. When the vehicle was delivered to MERADCOM, the pretest checks described in Appendix F of MERADCOM Report 2244 were conducted. A shakedown run was performed to familiarize the driver with the operating characteristics of the vehicle and to verify proper operation of all instrumentation systems. All tests were run in accordance with the DOE Electric and Hybrid Vehicle Test and Evaluation Procedures (Appendix A of MERADCOM Report 2244). All tests were performed at a gross vehicle weight of 2250 kg (4960 lb).

a. Maximum Speed. The maximum speed of the vehicle is measured during the acceleration coast-down tests. It is defined as the maximum speed that can be reached under full power on the Aberdeen Proving Ground 3-mi straightaway track.

b. Maximum Cruise Speed. The MERADCOM facility has a 2.0-km (1.24-mi) loop with a total of 1.46 km (0.91 mi) at a 1-percent grade, 0.36 km (0.23 mi) at a 3-percent grade, and 0.23 km (0.14 mi) at a 5-percent grade. The maximum maintainable speed on this partially level track is measured. If the vehicle's maximum speed exceeds the safe limits of the MERADCOM Test Track, the 3-mi track at APG is used.

c. Range Tests (Constant Speed). Range tests at constant speeds of 25, 35, 45, and 55 mi/h are carried out on the MERADCOM loop. The vehicle is driven until it can no longer maintain at least 95 percent of the designated test speed on the level portion of the loop.

d. Range Tests (Driving Cycles). The vehicle is tested on a level track, driving the SAE J277a simulated citylike acceleration, cruise, coast, brake, and idle cycle repetitively until the vehicle can no longer meet acceleration to time requirements. The EVA Current Fare Wagon was run through B-cycle (20 mi/h), C-cycle (30 mi/h), and D-cycle (45 mi/h) tests. For further information concerning cycle test details and selection criteria see Appendix A of MERADCOM Report 2244.

The Brake portion of the cycle testing of the EVA Current Fare Wagon posed something of a dilemma, since the vehicle regeneratively brakes during this period. This regenerative braking action can cause the average cycle distance to be reduced. However, the additional energy obtained through regeneration more than offsets this reduction.

e. Maximum Acceleration. Maximum acceleration is calculated from the recorded time and velocity data. The tests are conducted on the 3-mi straightaway at APG. The vehicle is maximally accelerted within manufacturer's recommended standards for the vehicle, allowed to cruise a short time at that speed, and then allowed to free-wheel coast down to a stop. The vehicle is run through this cycle repetitively until the traction battery is discharged, then the test is terminated. This test is performed with the vehicle instrumented as indicated in Section V.

Computer analysis is used to determine which of the cycles corresponds to 0-, 40-, and 80-percent states of battery discharge.

f. Gradeability. Gradeability is the grade in percent which the vehicle is able to traverse at any selected speed. It is calculated from maximum acceleration tests by using the equation:

$$G = 100 \tan (\sin^{-1} 0.0455a_n)\%$$

where:

a_n = acceleration in miles per hour per second.

g. Coast-Down Tests. As indicated above, the coast-down tests are an intimate part of the acceleration tests. The following data result:

- **Road Energy Consumption:** Road energy is a measure of the energy consumed overcoming the vehicle's aerodynamic and rolling resistance.

- The road energy for the vehicle at various speeds and the losses in the drive train were determined from coast-down tests. Road energy E_n is calculated from the following equation:

$$E_n = 9.07 \times 10^{-5} W \frac{V_{n-1} - V_n}{t_n - t_{n-1}} \frac{\text{kWh}}{\text{mi}}$$

where:

V = vehicle speed, mi/h

W = gross vehicle weight, lb

t = Time, s

$$\frac{V_{n-1} - V_n}{t_n - t_{n-1}} = a, \text{ mi/h/s.}$$

• **Road Power Requirements.** Road power is a measure of vehicle aerodynamic and rolling resistance. The road power, P_n, required to propel a vehicle at speed n is determined from coast-down tests. The following equation was used:

$$P_n = 6.08 \times 10^{-5} \, W \left(\frac{V^2_{n-1} - V^2_n}{t_n - t_{n-1}} \right) \text{kW}$$

where:

W = Gross Vehicle Test Weight, lb

V = Vehicle Speed, mi/h

t = Time, s.

h. Tractive Force Tests. The maximum-grade capability of the test vehicle is determined from tractive force tests by towing a field dynamometer at approximately 1.6 km/h (1 mi/h) while the test vehicle is being driven with wide-open throttle. The force is measured by the dynamometer instrumentation from a load cell attached between the vehicles. The test is run with the batteries 0-, 40-, and 80-percent discharged. From the results of the tractive force tests, the gradeability limit is obtained. It is calculated from:

$$\text{Gradeability limit in percent} = 100 \tan \quad \sin\left(^{-1} \frac{P}{W}\right)$$

where:

P = tractive force (lb)

W = gross vehicle weight (lb).

VII. TEST RESULTS AND DISCUSSION

The data collected from all range tests are summarized in Table 1. The table shows the test data, type of test, environmental condition, the range test results, energy into and out of the battery, and the energy into the charger. These data are used to determine vehicle range, energy economy, and efficiencies.

a. Maximum Speed. The EVA Current Fare Wagon had an average maximum speed of 95.9 km/h (59.6 mi/h). This maximum cruise speed was beyond that which could be measured on the MERADCOM Test Track and was checked at APG.

b. Range (Constant Speed and Driving Cycles). The EVA Current Fare Wagon was tested at constant speeds: 40.2 km/h (25 mi/h), 56.3 km/h (35 mi/h), 72.4 km/h (45 mi/h), and 88.5 km/h (55 mi/h). It was also tested under B, C, and D driving cycles. All test results are summarized in Table 1. Velocity, voltage, current, and power curves for the third cycle and the next-to-last-cycle, representative of each type of driving cycle test, are given in Figures 8 through 31. The final portion of the power curves for each of the driving cycles is due to regenerative braking and was reversed in polarity by the computer analysis program. Figures 8 to 15 are from the schedule B cycle test performed on 28 August 1981. Figures 16 to 23 are from the schedule C cycle test performed on 31 August 1981. Figures 24 to 30 are from the schedule D cycle test performed on 3 September 1981. The numerical results are tabulated in Appendix B.

c. Maximum Acceleration. The EVA Current Fare Wagon accelerated to 50 km/h (31.1 mi/h) in 9.6 s and to 80.4 km/h (50 mi/h) in 31.2 s; both values are averages based on at least 10 runs.

- **Velocity.** Velocity versus time of the Current Fare Wagon is given 0-, 40-, and 80-percent depths of discharge (DOD) in Figure 32.

- **Acceleration vs. Velocity.** Figures 33a, b, and c show vehicle acceleration versus velocity for 0-, 40-, and 80-percent DOD, respectively.

- **Gradeability at Speed.** Figures 34a, b, and c give the Current Fare Wagon gradeability at speed for 0-, 40-, and 80-percent DOD of the traction battery, respectively.

d. Coast-Down Tests. From the coast-downs, the velocity versus (Figure 35) was obtained for the 0-, 40-, and 80-percent DOD. The coast-down portion of the acceleration coast-down tests yielded the following results:

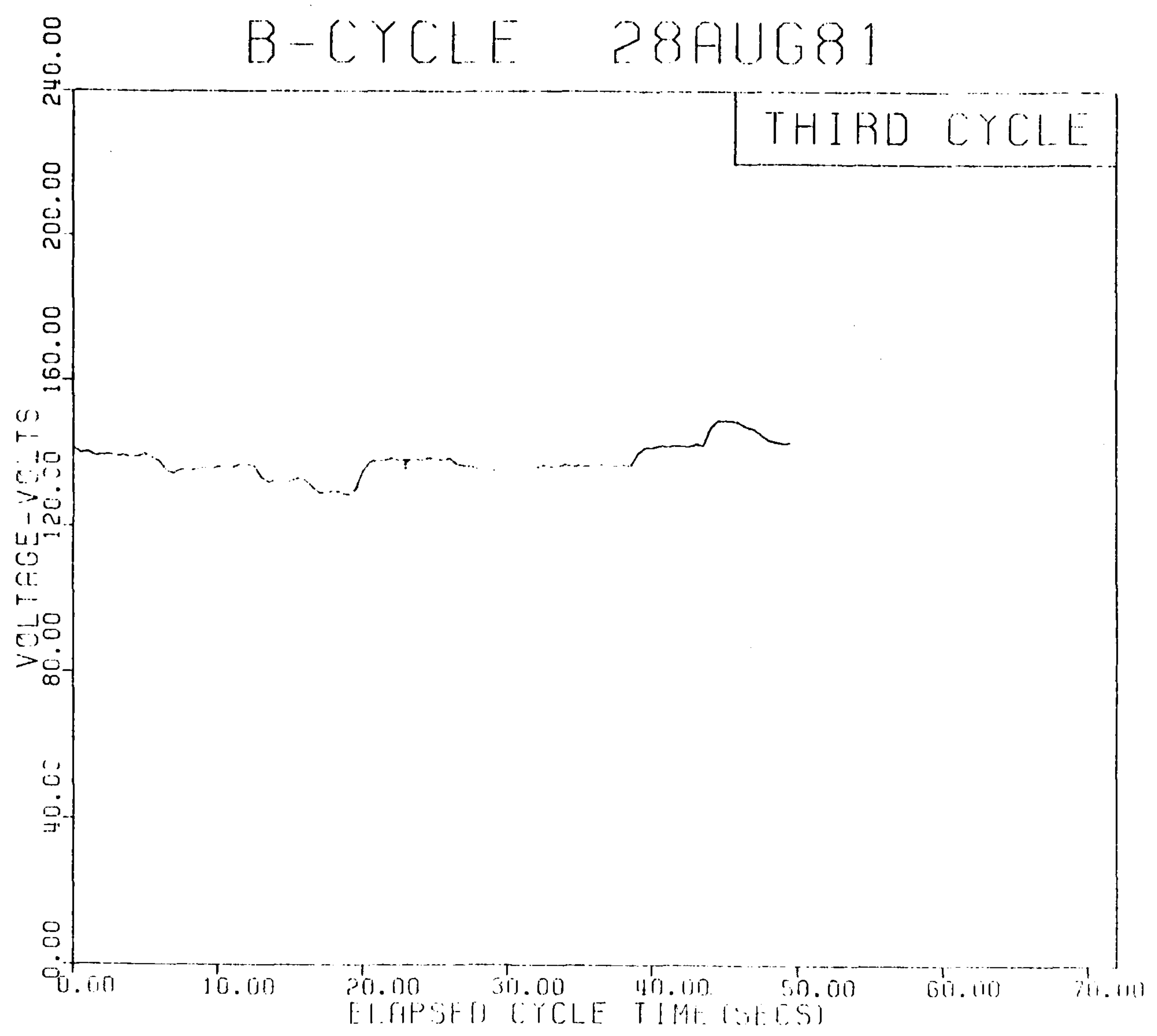


Figure 8. Driving cycle test curve: voltage, B cycle, 28 Aug 81, 3rd cycle.

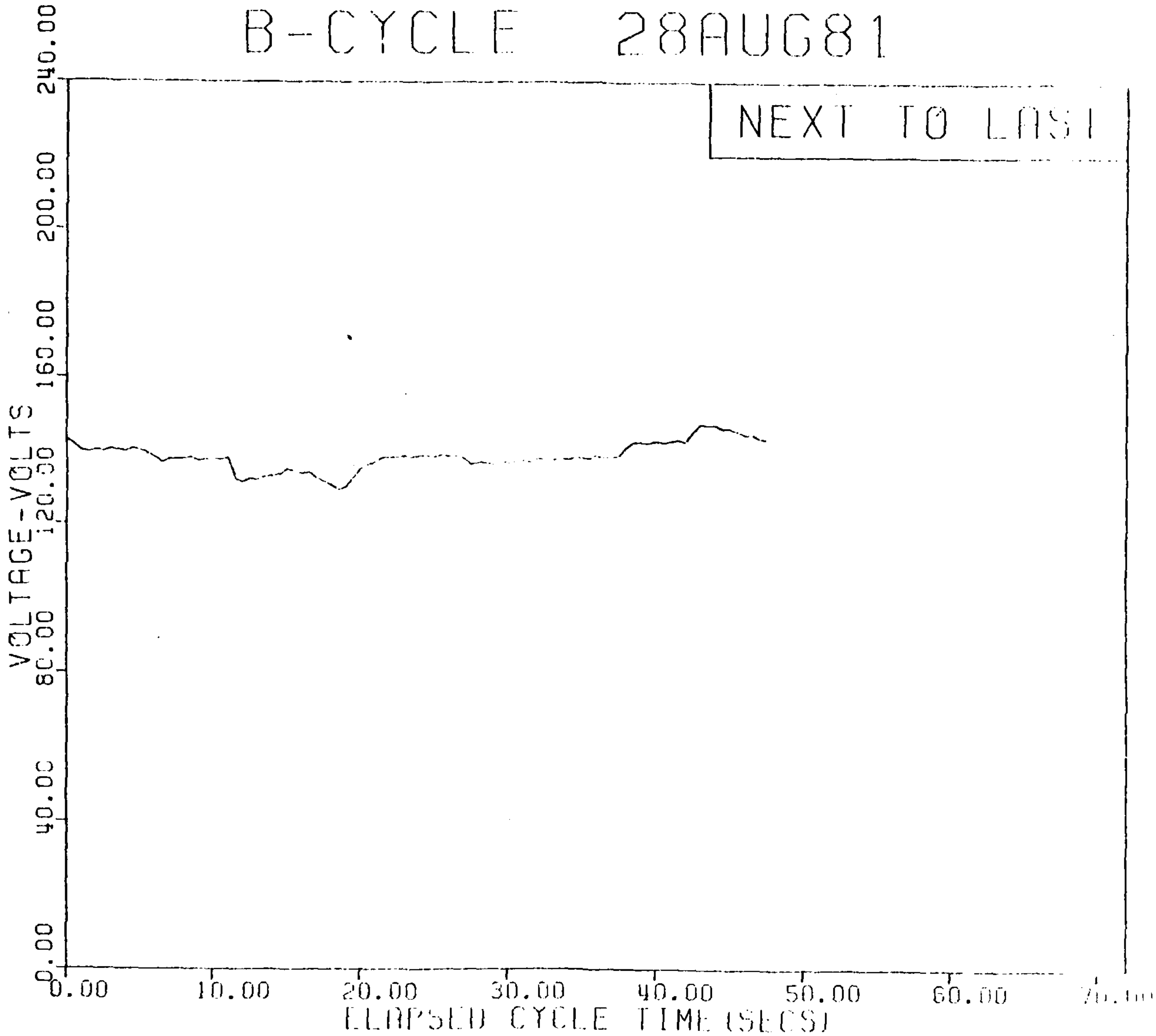


Figure 9. Driving cycle test curve: voltage, B cycle, 28 Aug 81, next-to-last cycle.

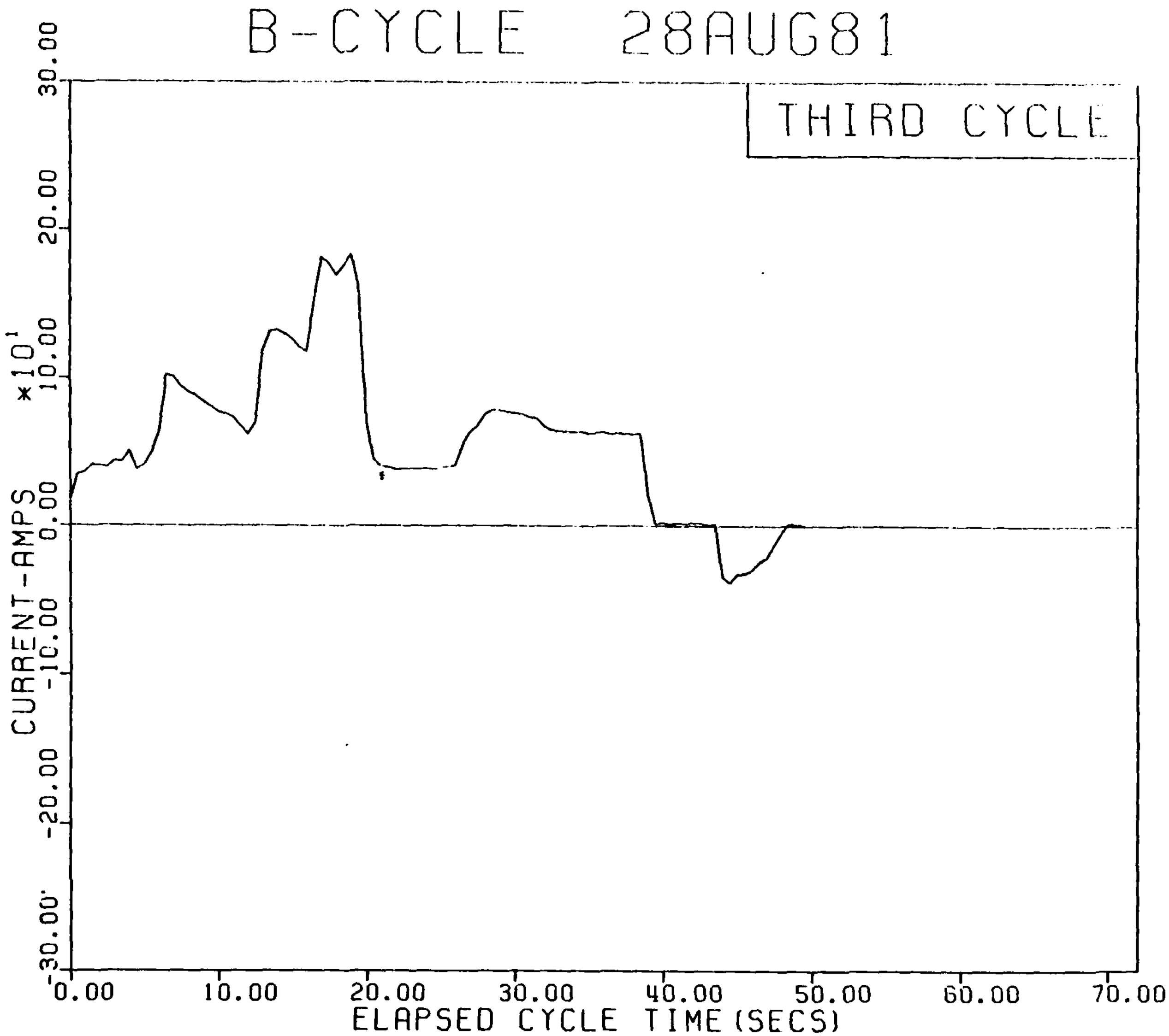


Figure 10. Driving cycle test curve: current, B cycle, 28 Aug 81, 3rd cycle.

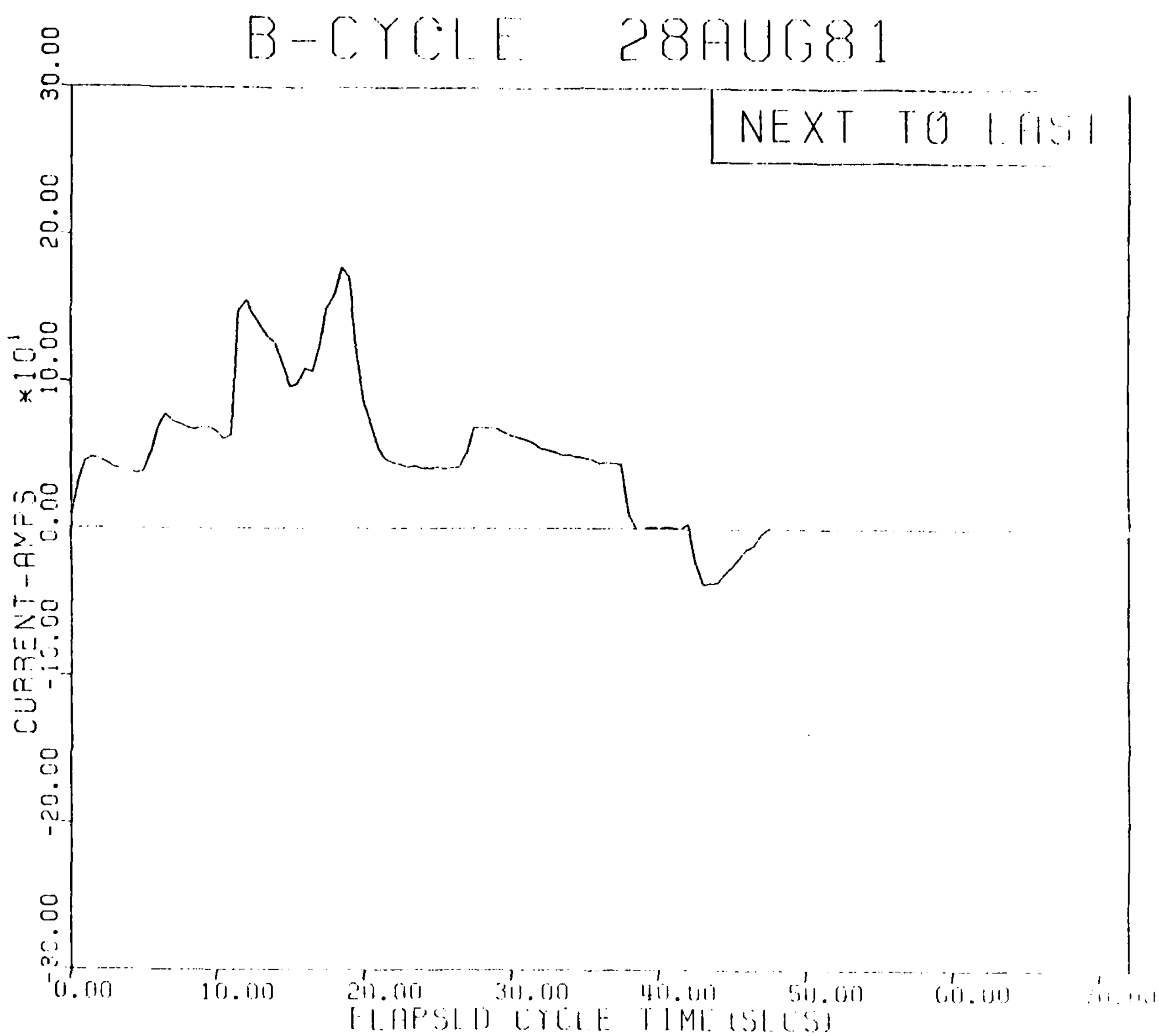


Figure 11. Driving cycle test curve: current, B cycle, 28 Aug 81, next-to-last cycle.

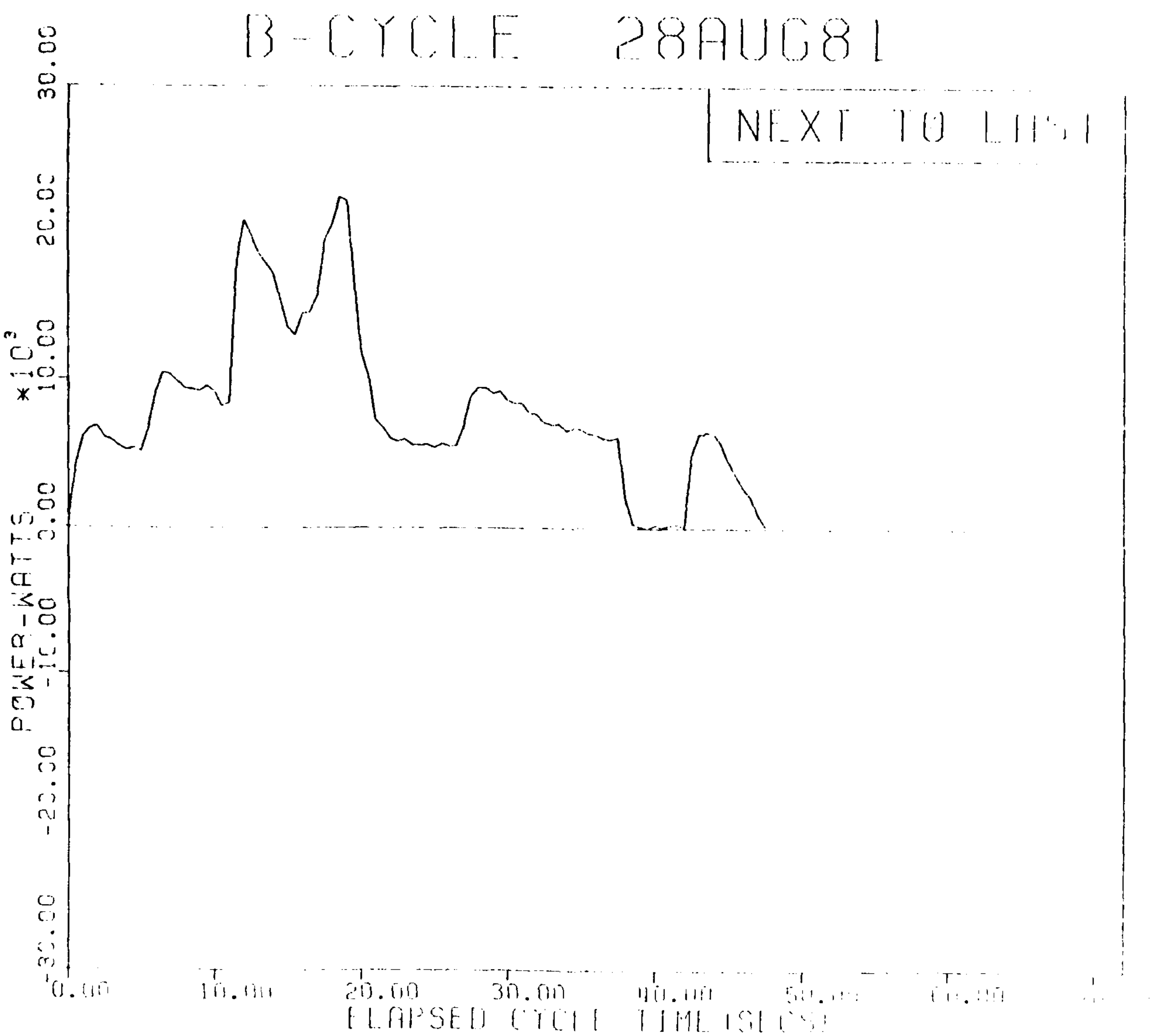


Figure 12. Driving cycle test curve: power, B cycle, 28 Aug 81, 3rd cycle.

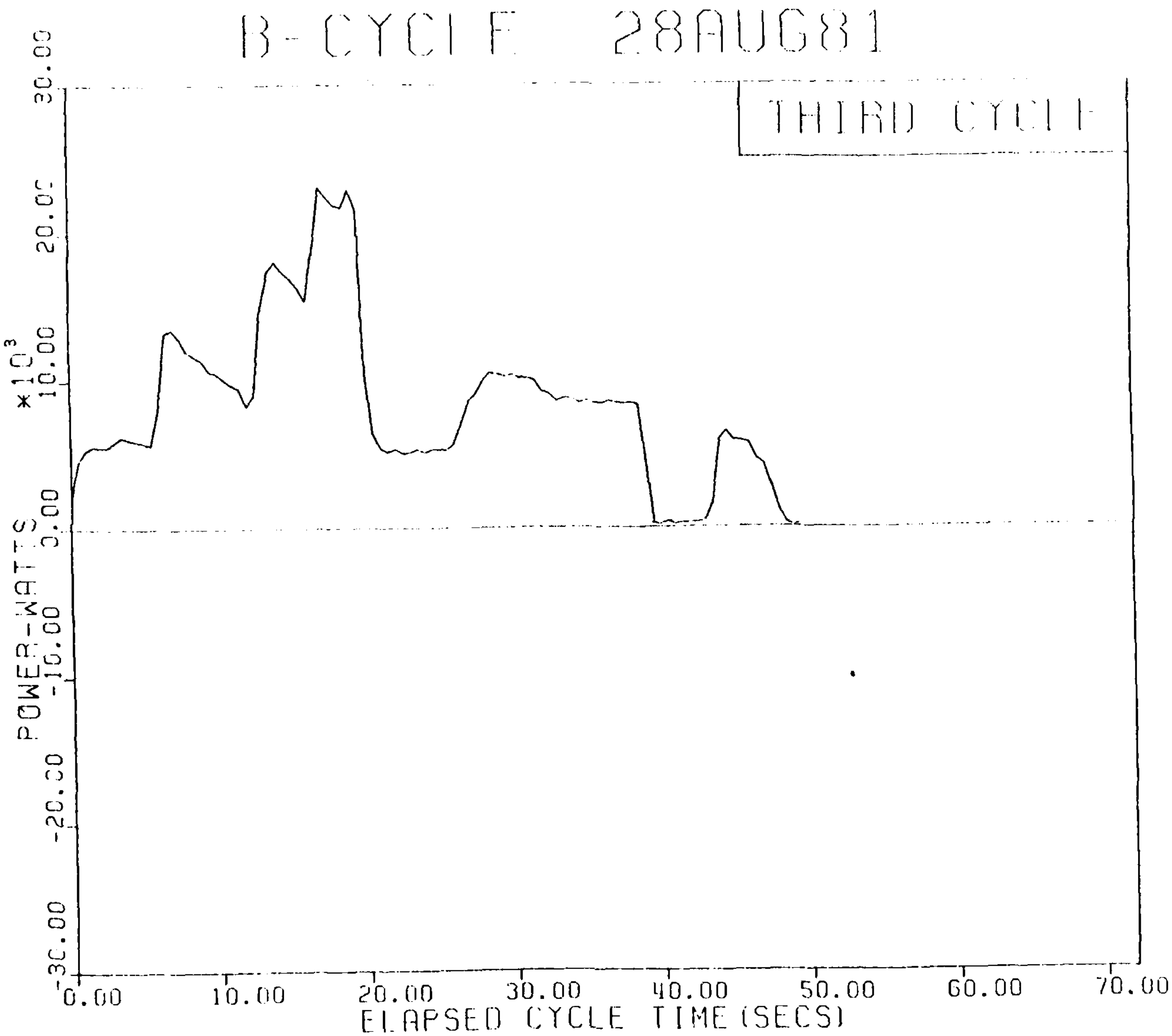


Figure 13. Driving cycle test curve: power, B cycle, 28 Aug 81, next-to-last cycle.

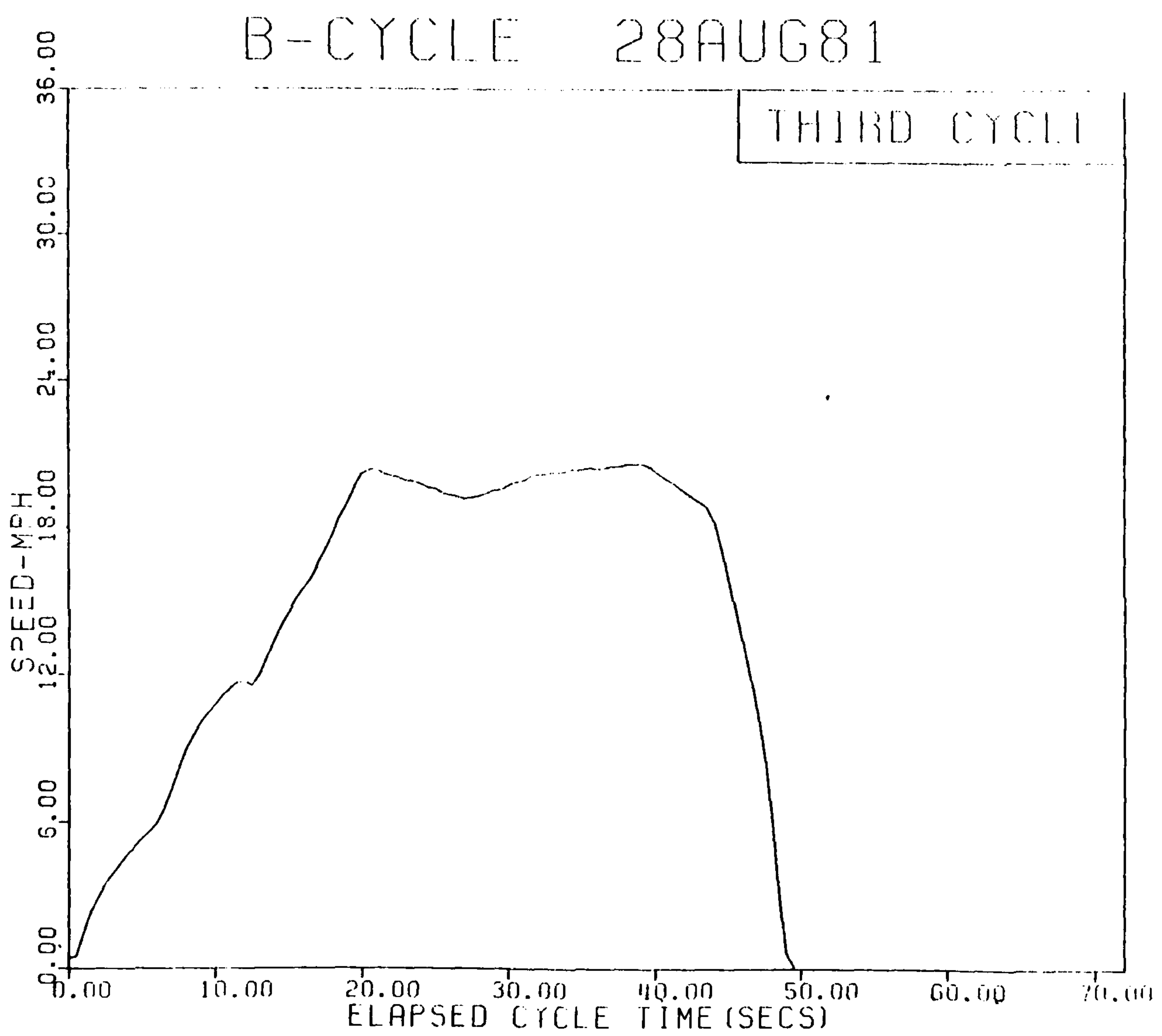


Figure 14. Driving cycle test curve: speed, B cycle, 28 Aug 81, 3rd cycle.

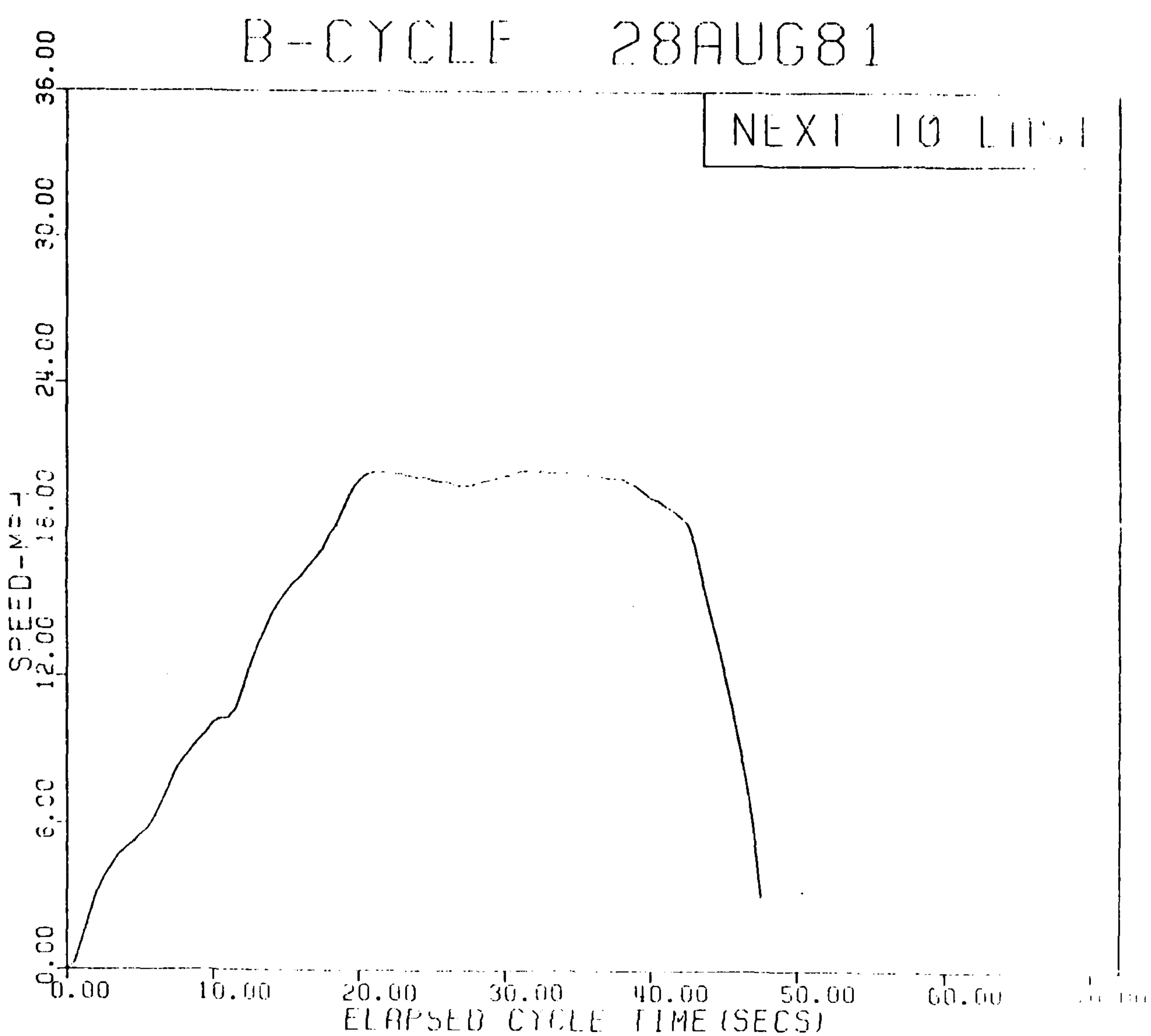


Figure 15. Driving cycle test curve: speed, B cycle, 28 Aug 81, next-to-last cycle.

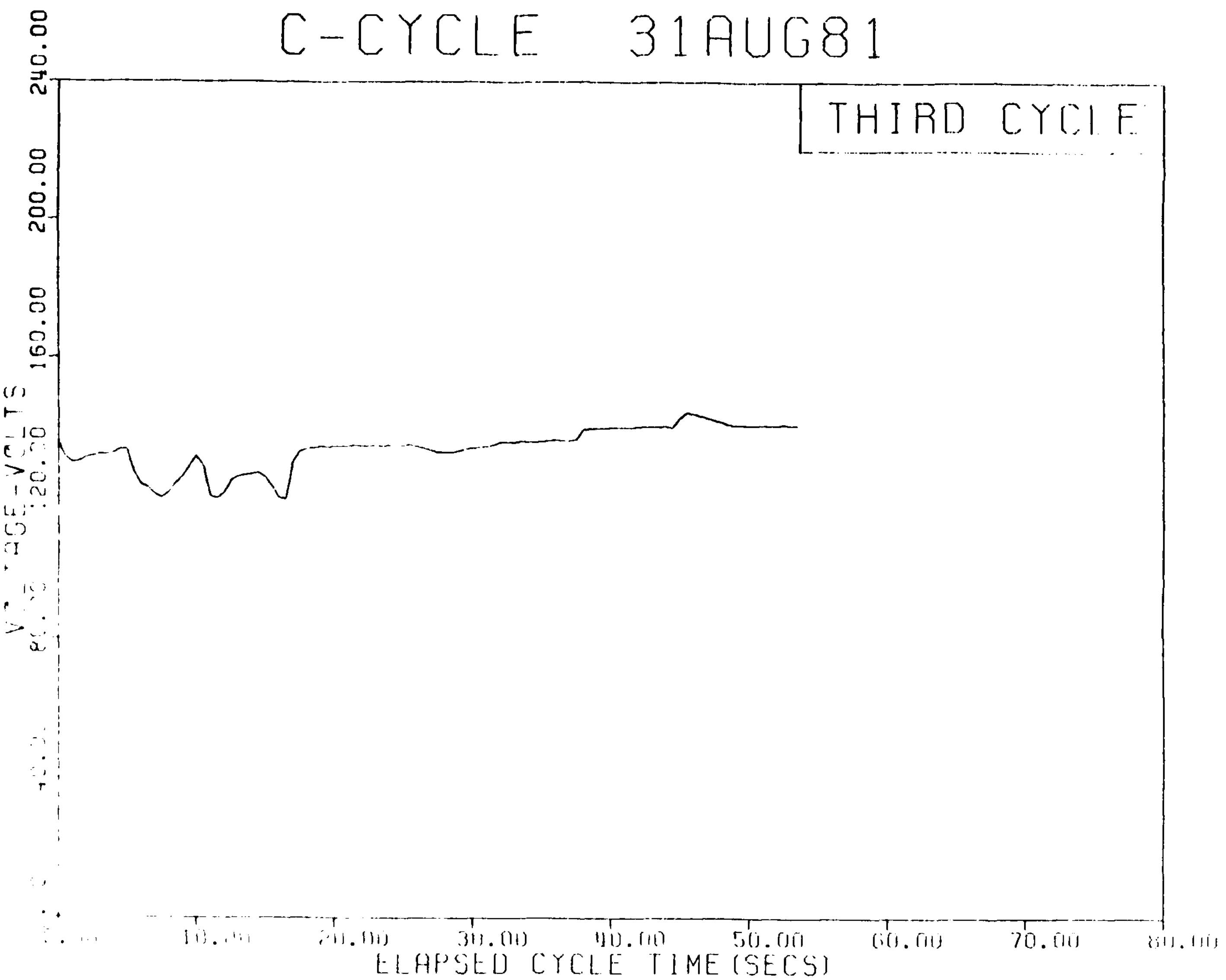


Figure 16. Driving cycle test curve: voltage, C cycle, 31 Aug 81, 3rd cycle.

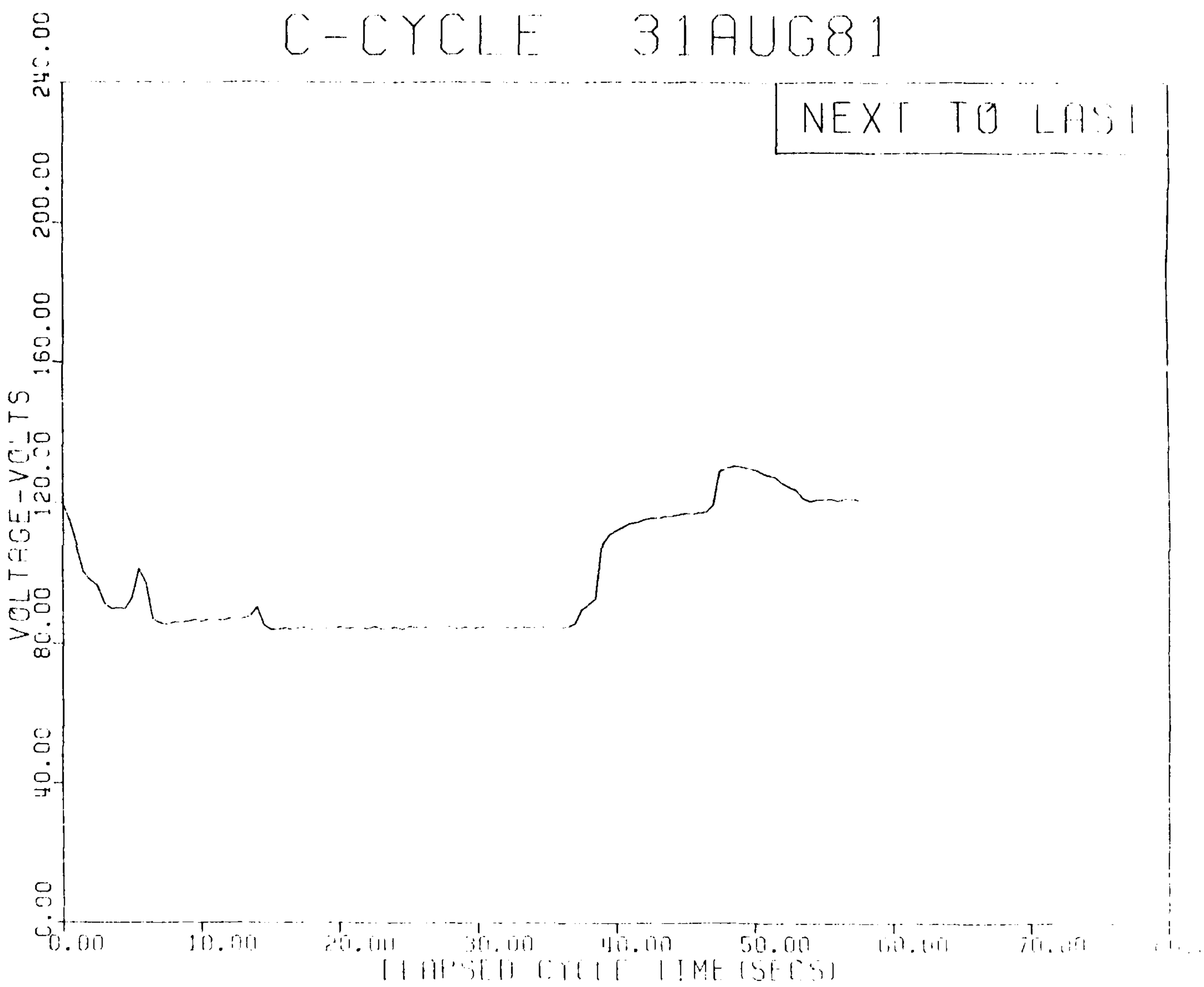


Figure 17. Driving cycle test curve: voltage, C cycle, 31 Aug 81, next-to-last cycle.

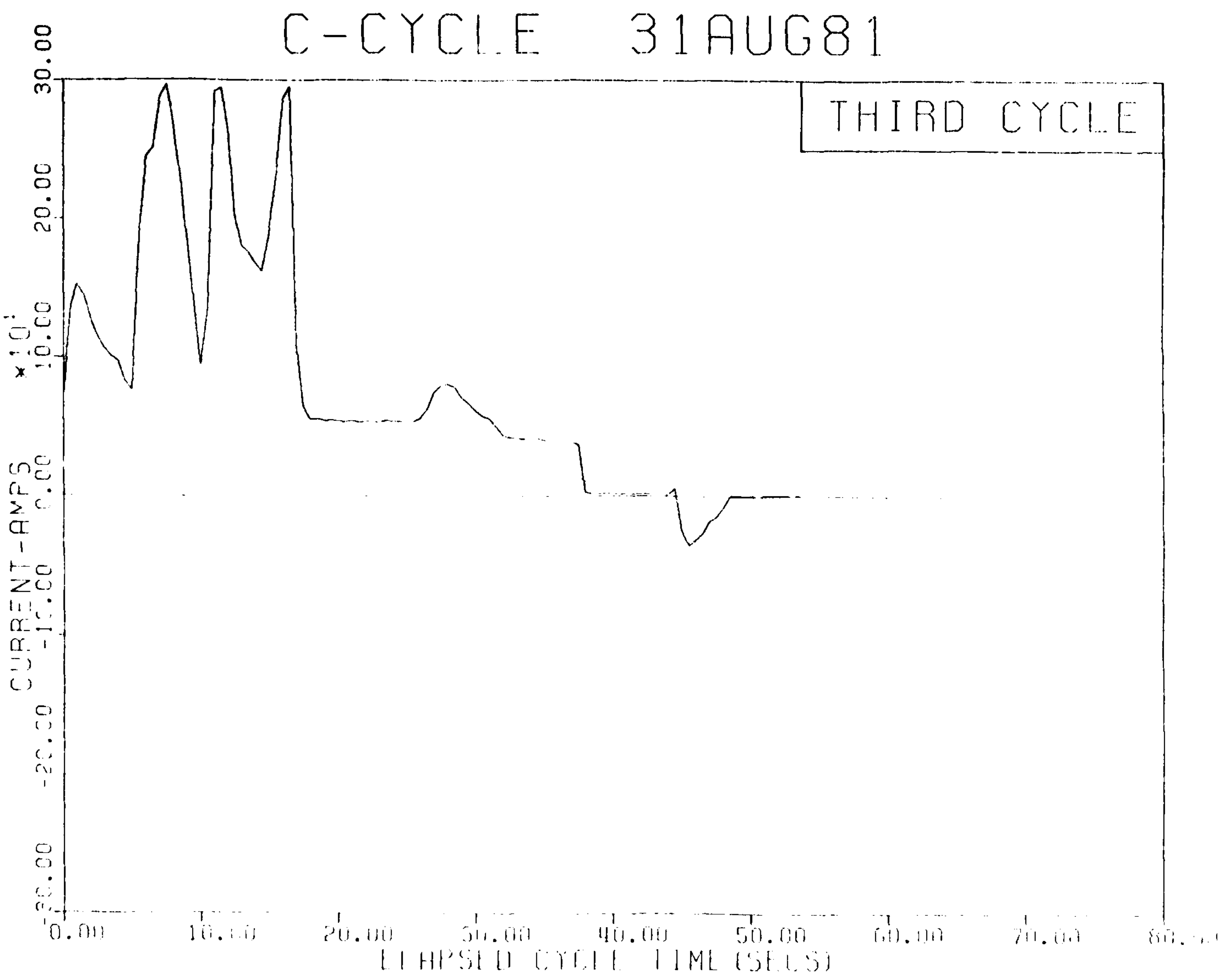


Figure 18. Driving Cycle Test Curve: current, C cycle, 31 Aug 81, 3rd cycle.

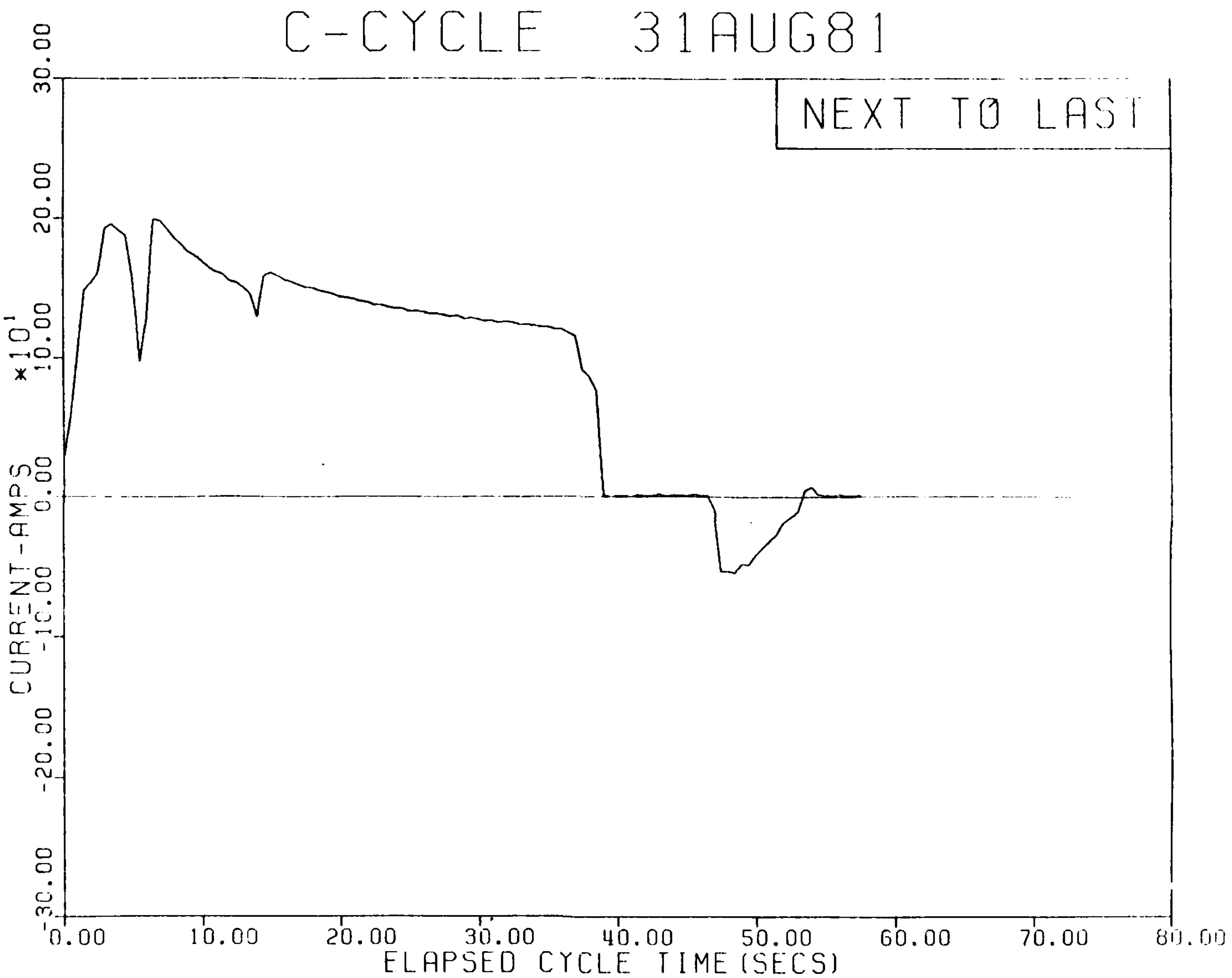


Figure 19. Driving cycle test curve: current, C cycle, 31 Aug 81, next-to-last cycle.

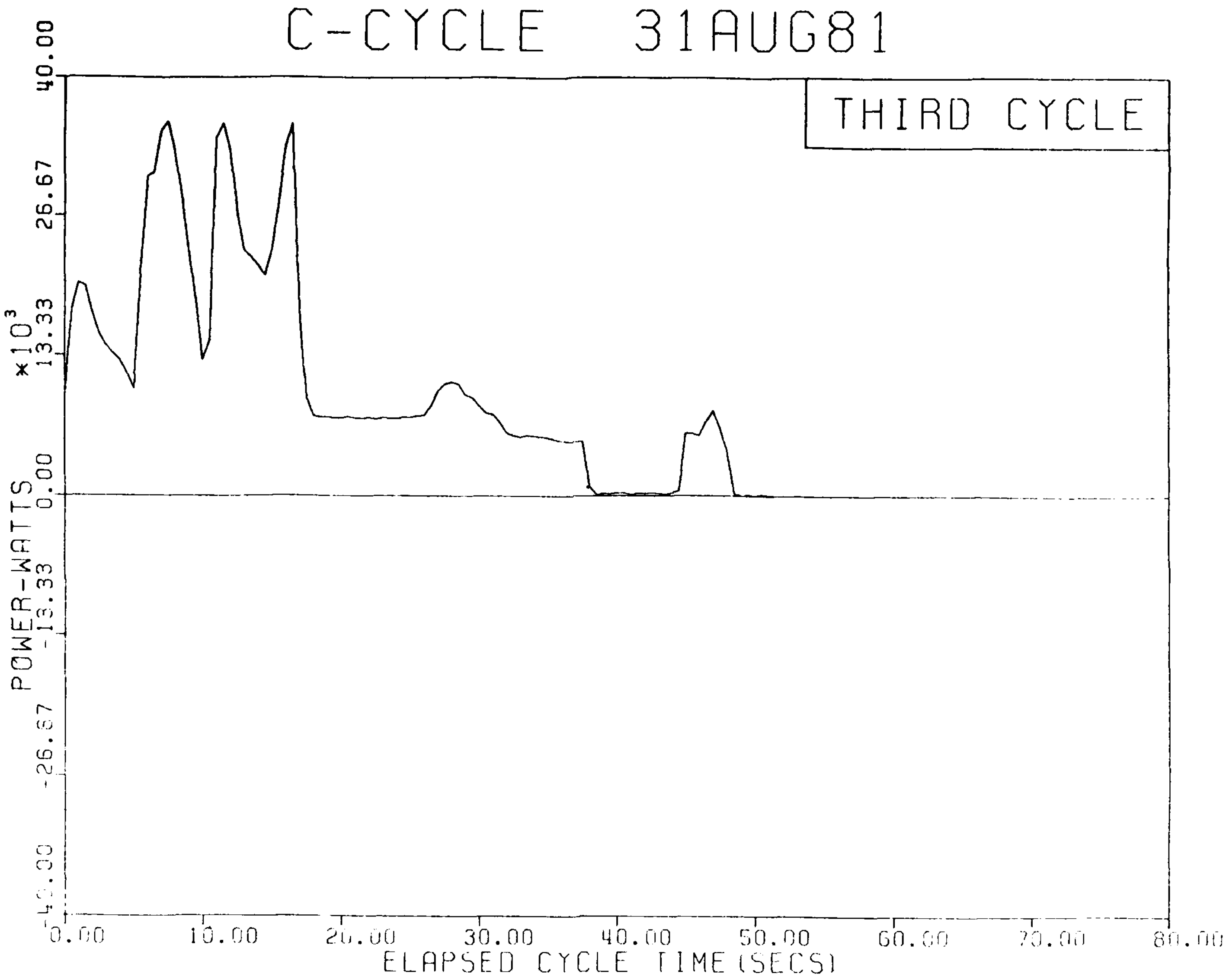


Figure 20. Driving cycle test curve: power, C cycle, 31 Aug 81, 3rd cycle.

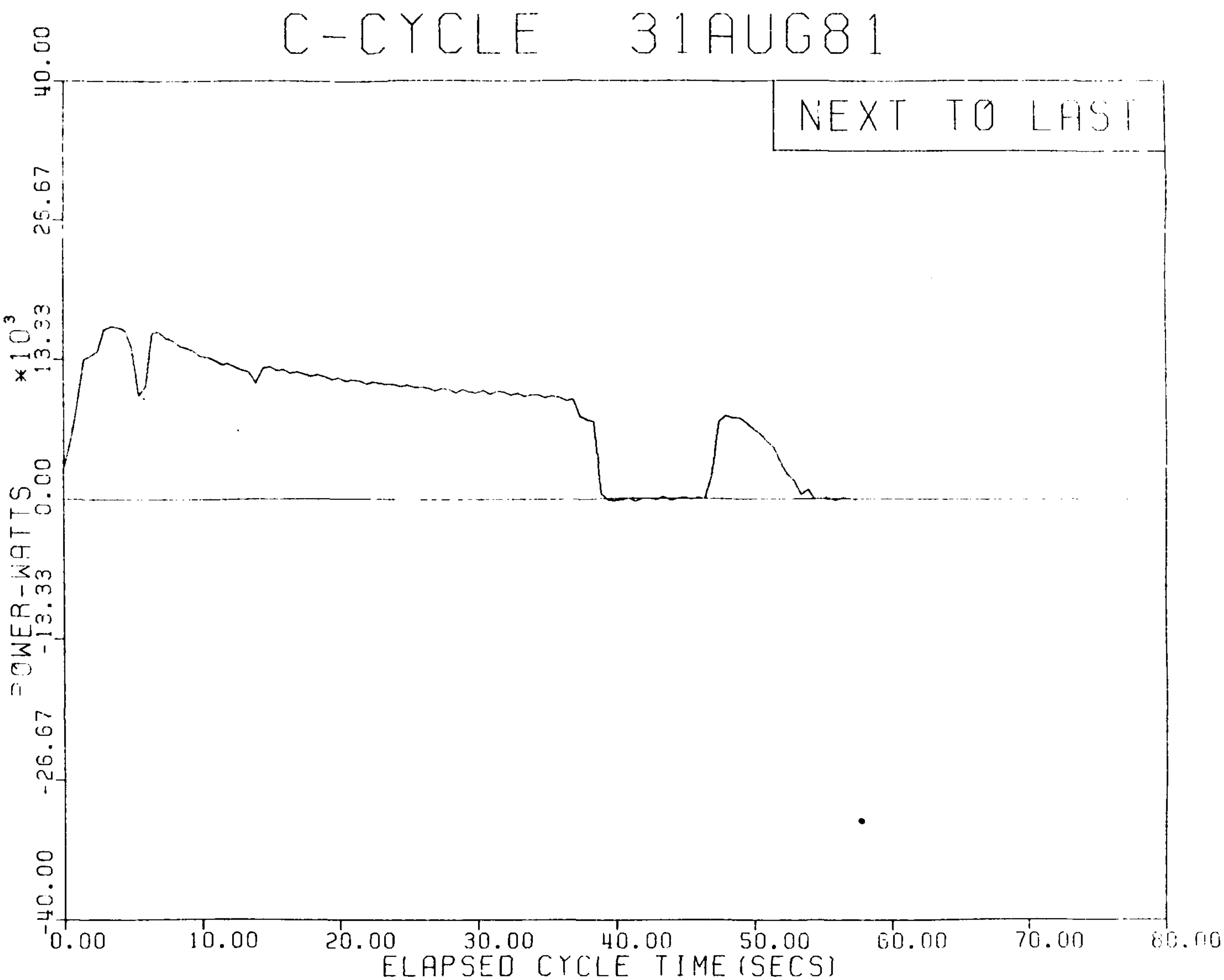


Figure 21. Driving cycle test curve: power, C cycle, 31 Aug 81, next-to-last cycle.

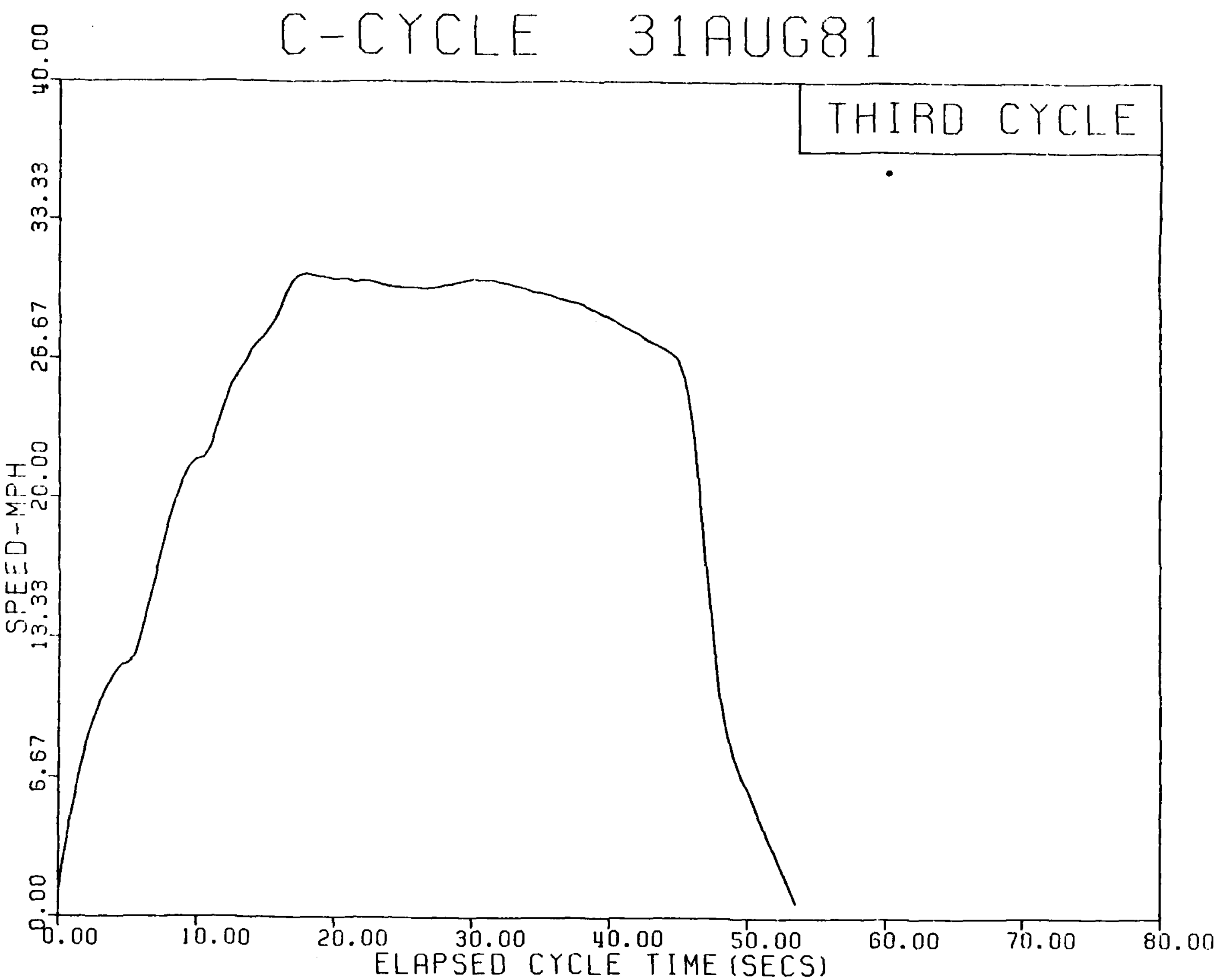


Figure 22. Driving cycle test curve: speed, C cycle, 31 Aug 81, 3rd cycle.

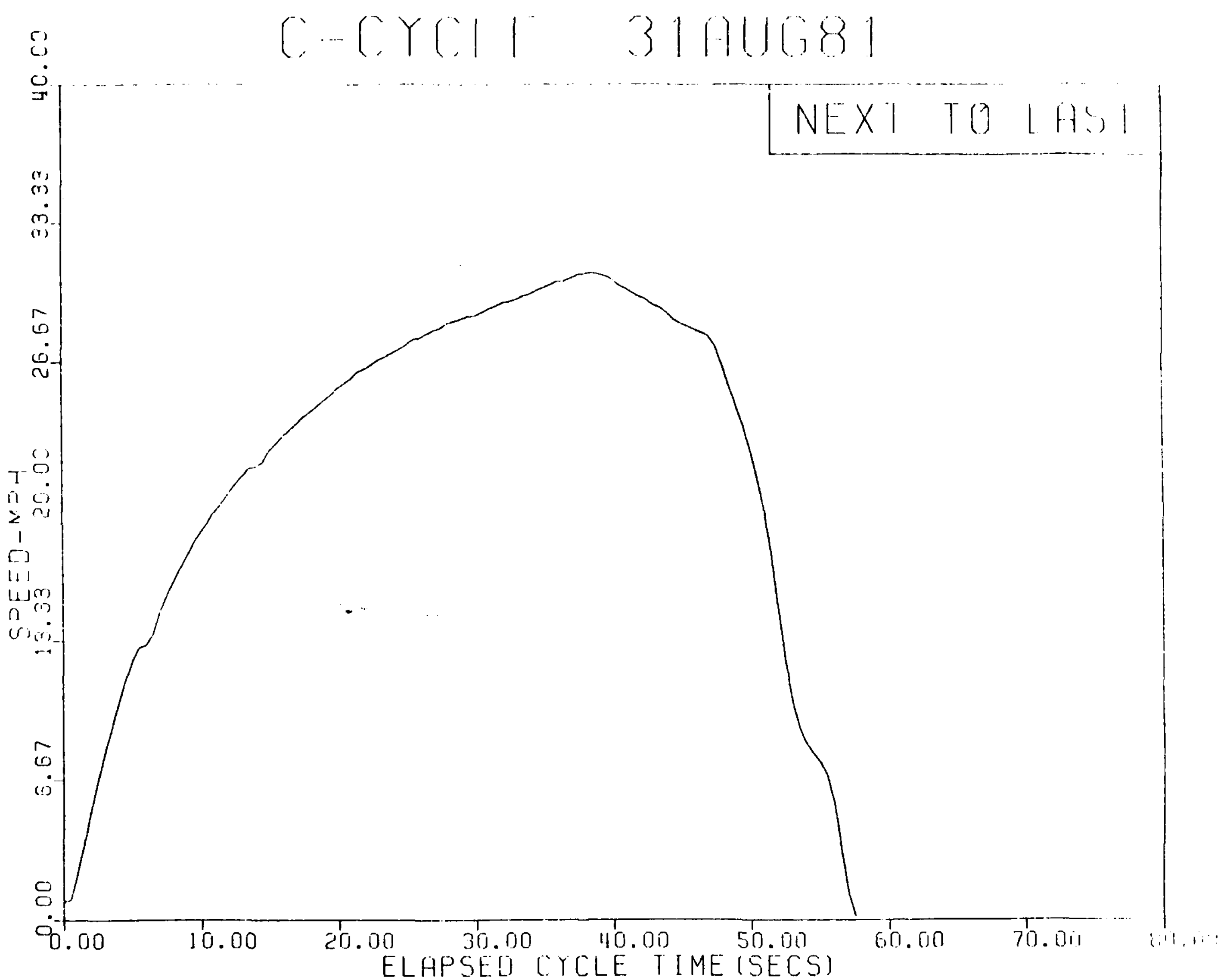


Figure 23. Driving cycle test curve: speed, C cycle, 31 Aug 81, next-to-last cycle.

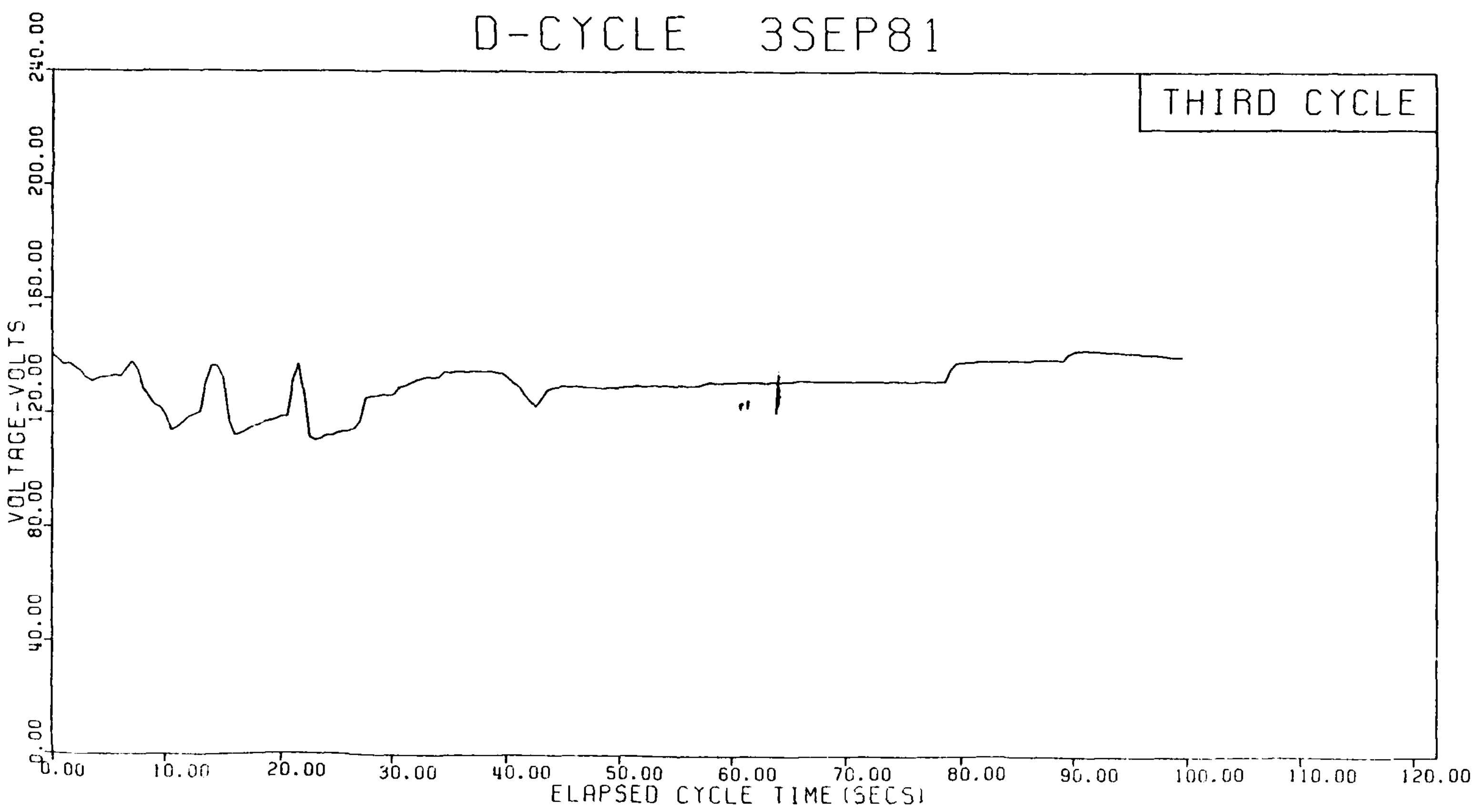


Figure 24. Driving cycle test curve: voltage, D cycle, 3 Sep 81, 3rd cycle.

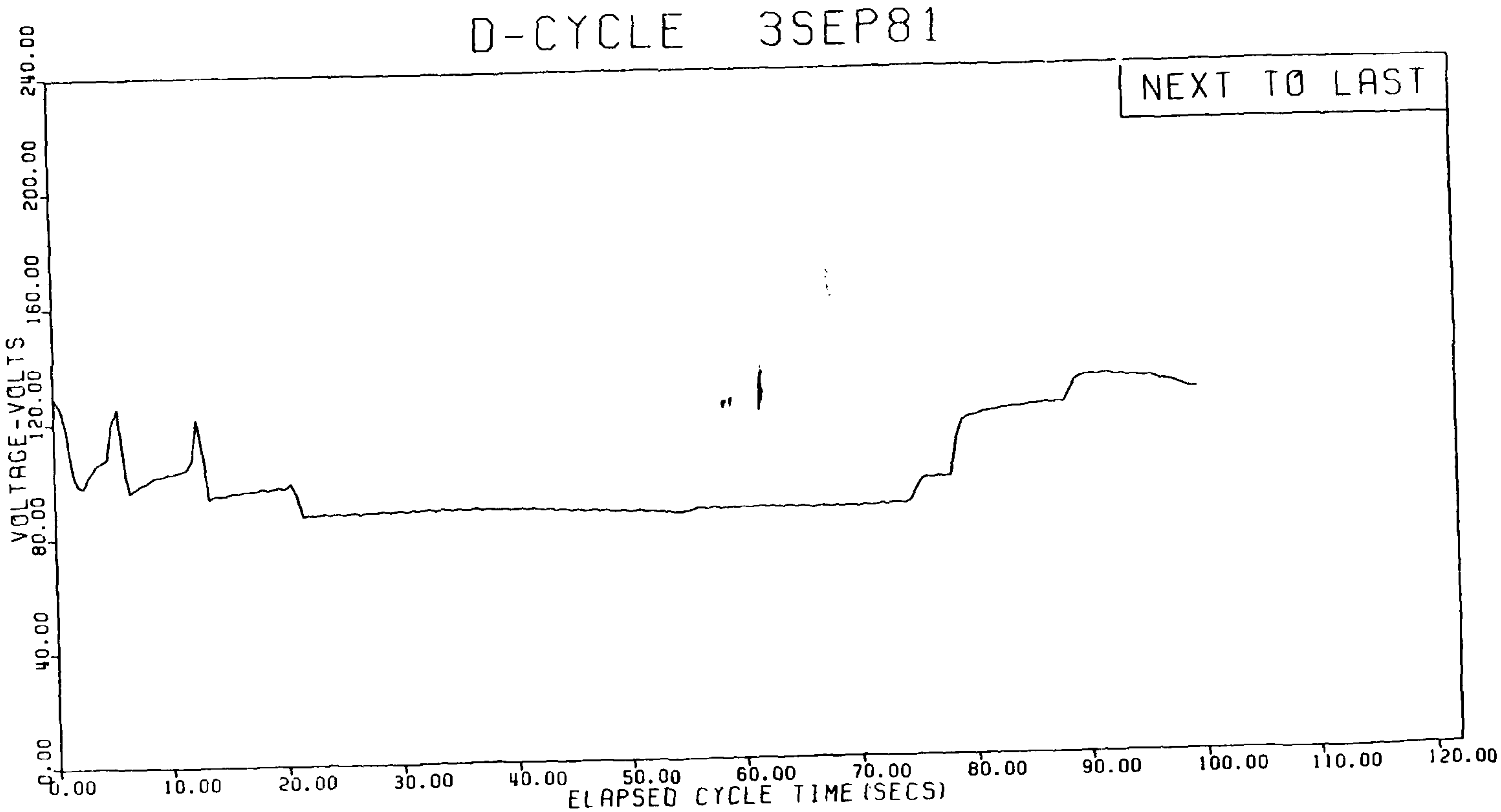


Figure 25. Driving cycle test curve: voltage, D cycle, 3 Sep 81, next-to-last cycle.

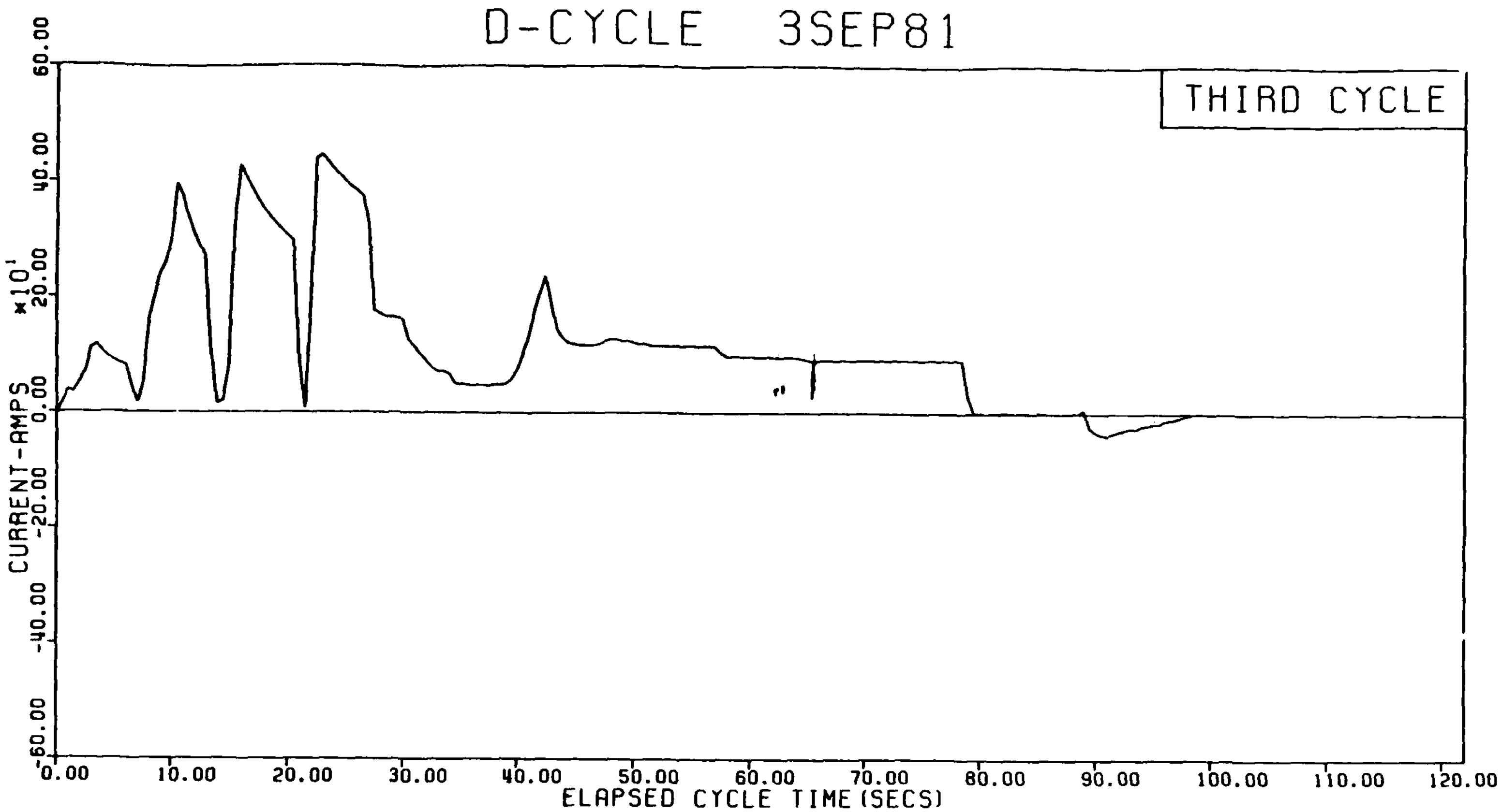


Figure 26. Driving cycle test curve: current, D cycle, 3 Sep 81, 3rd cycle.

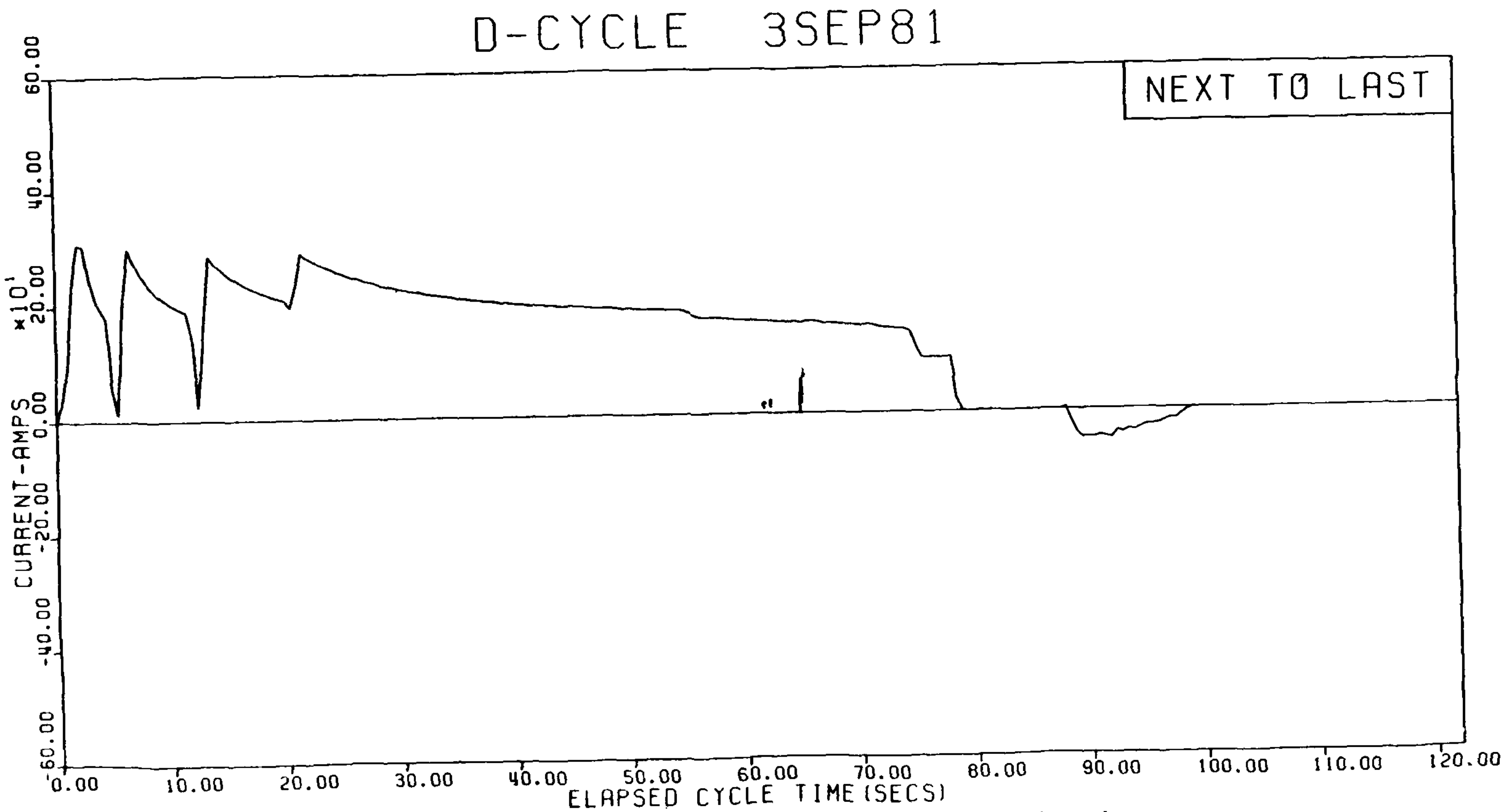


Figure 27. Driving cycle test curve: current, D cycle, 3 Sep 81, next-to-last cycle.

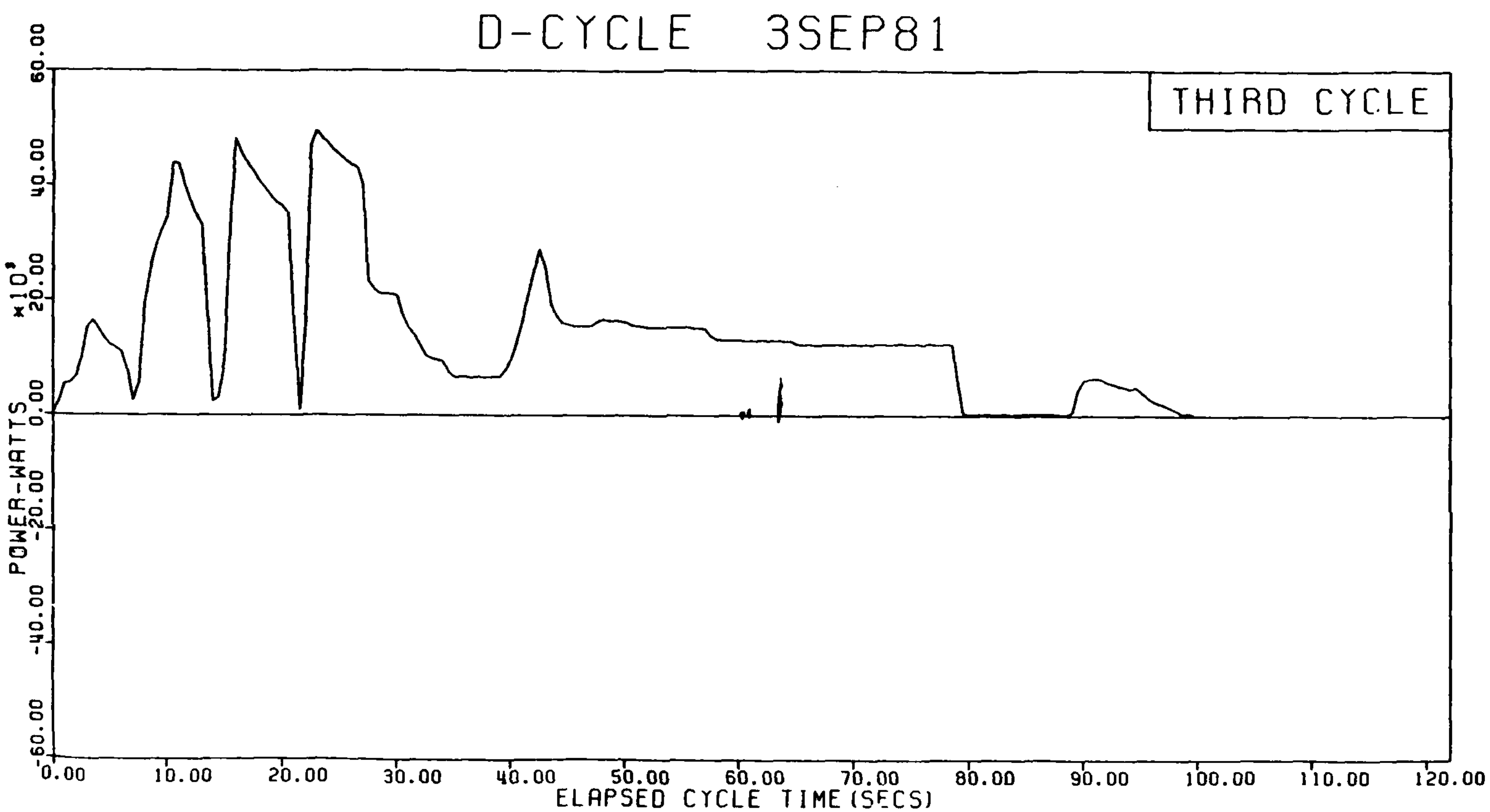


Figure 28. Driving cycle test curve: power, D cycle, 3 Sep 81, 3rd cycle.

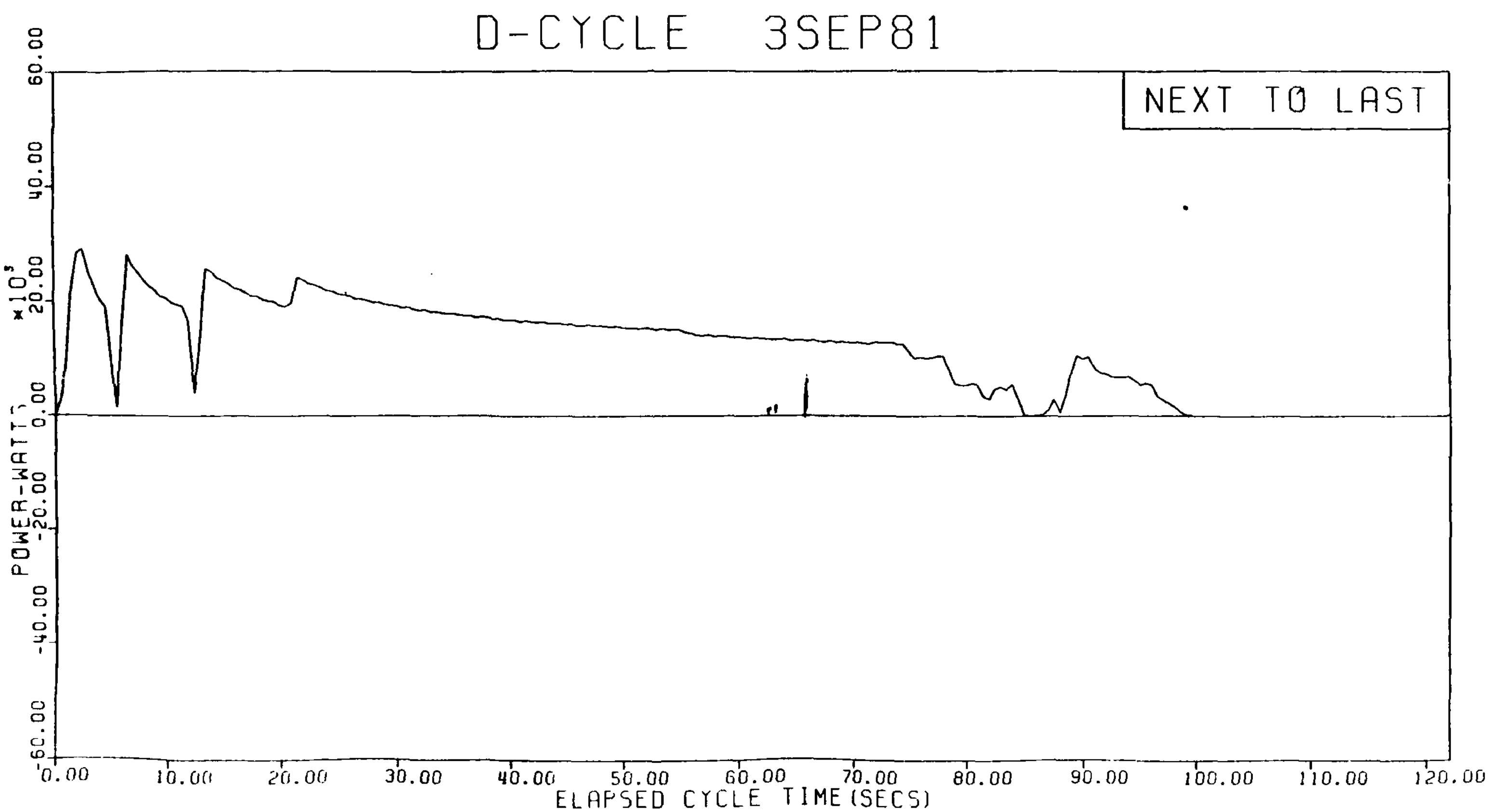


Figure 29. Driving cycle test curve: power, D cycle, 3 Sep 81, next-to-last cycle.

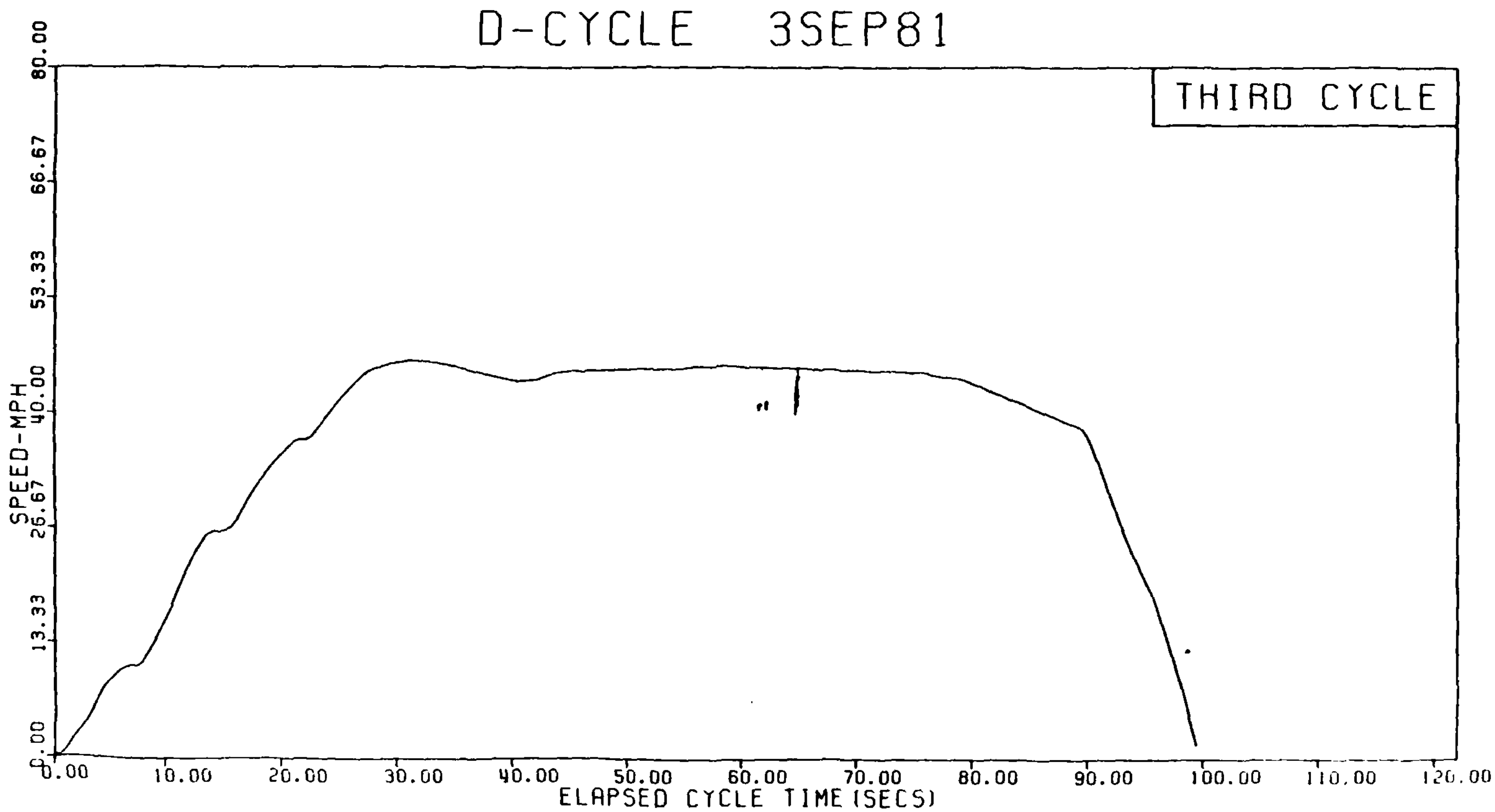


Figure 30. Driving cycle test curve: speed, D cycle, 3 Sep 81, 3rd cycle.

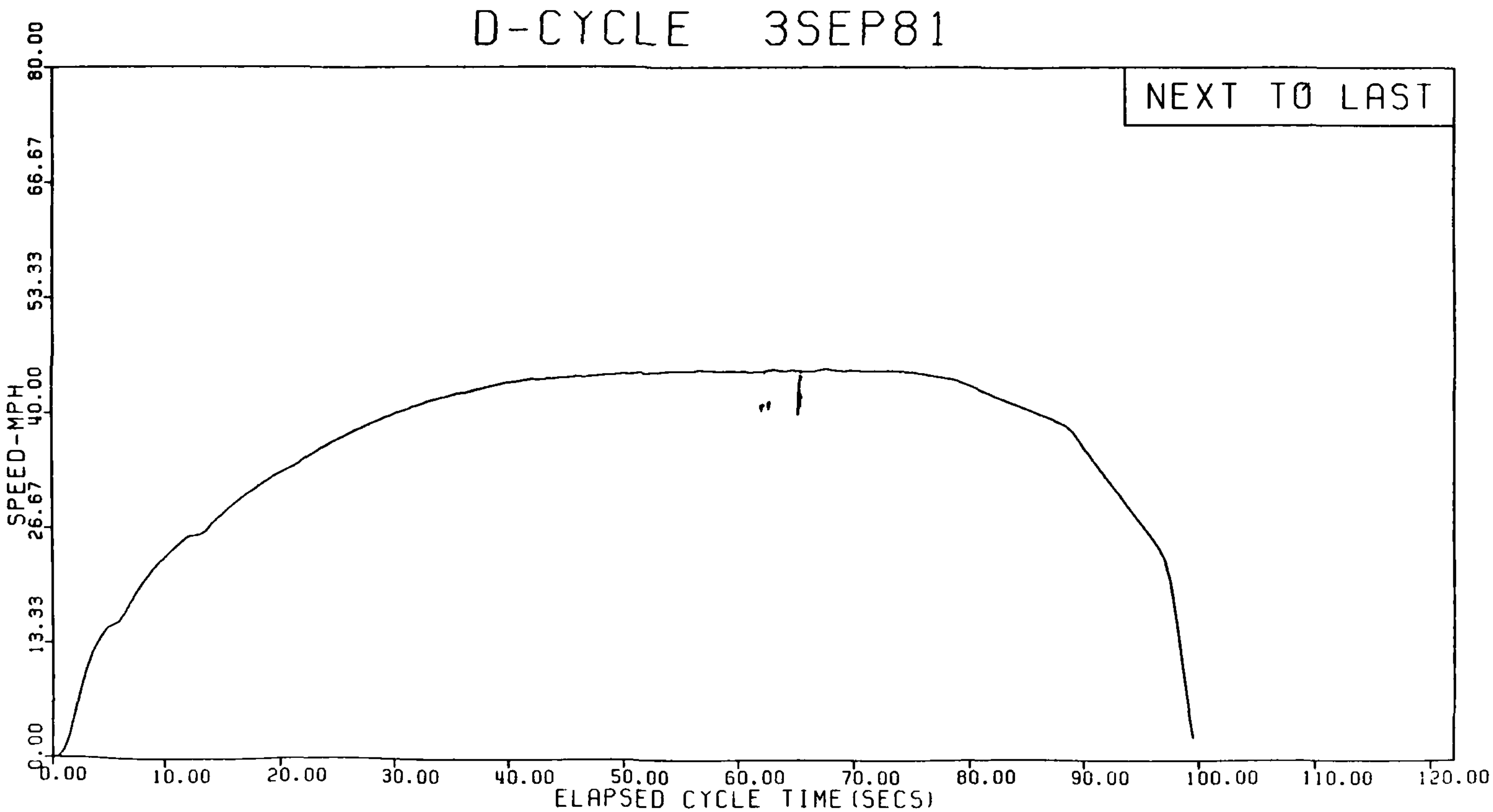


Figure 31. Driving cycle test curve: speed, D cycle, 3 Sep 81, next-to-last cycle.

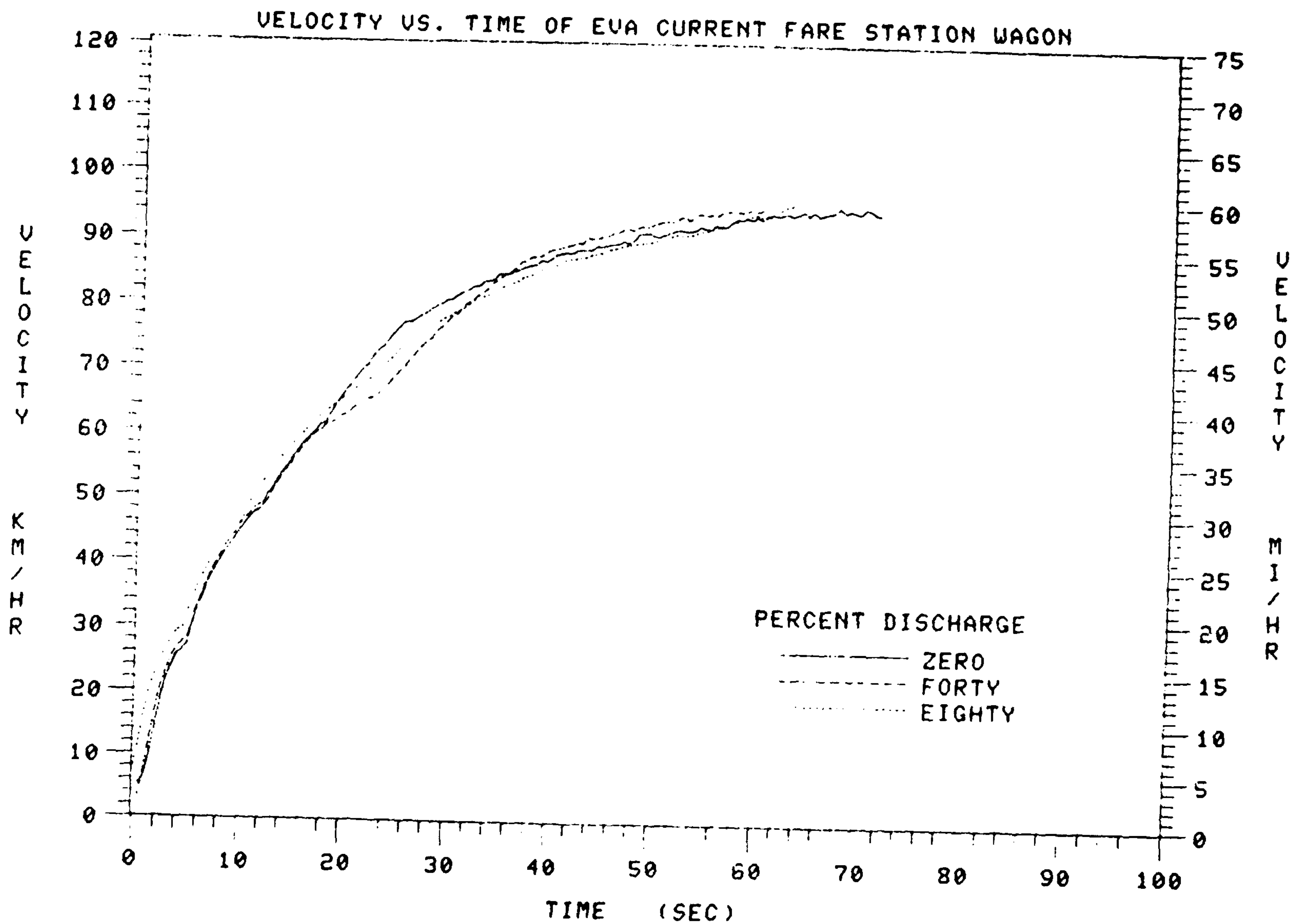


Figure 32. Velocity vs time, current fare wagon.

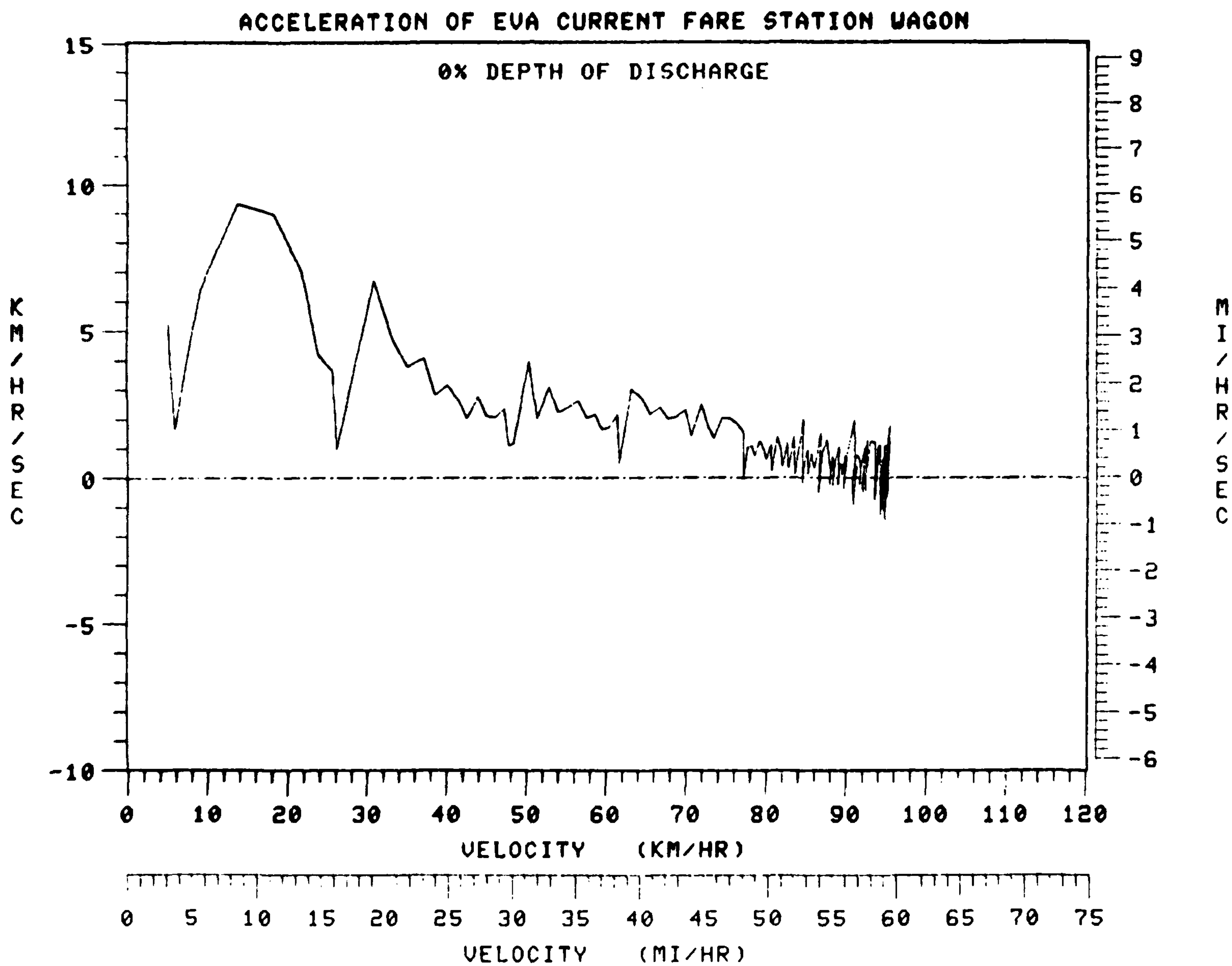
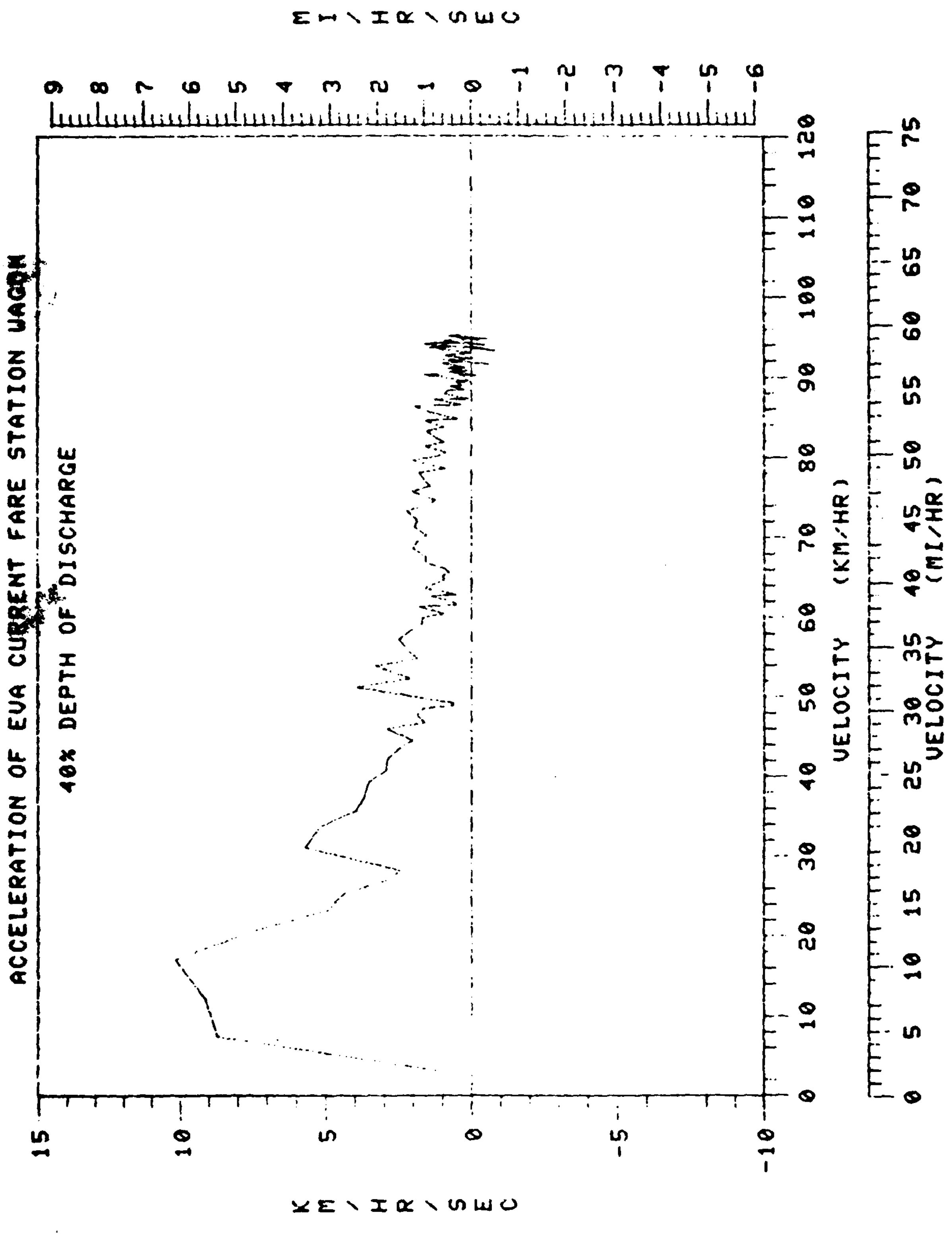
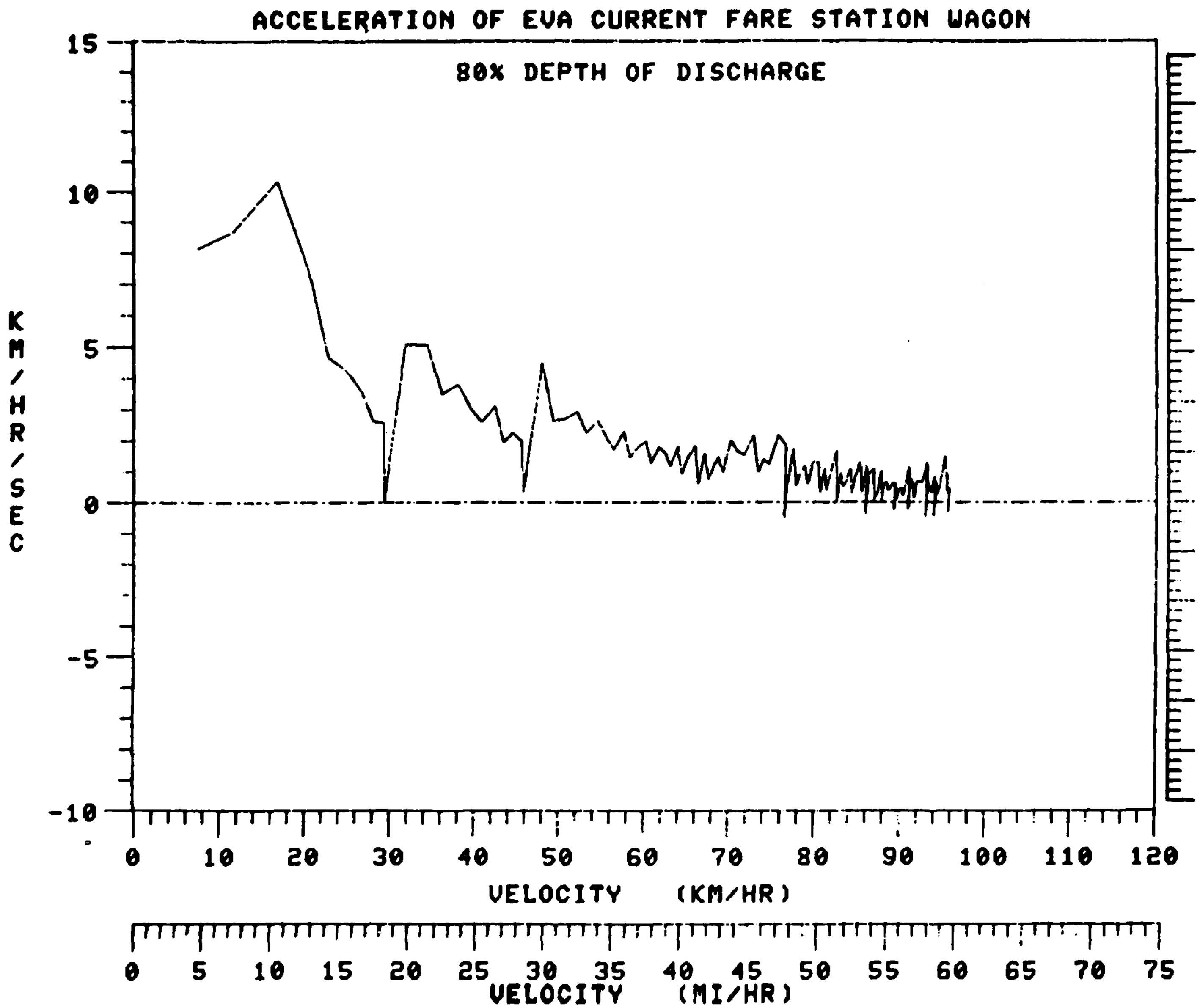


Figure 33. Acceleration of current fare wagon: a. 0% DOD.



ACCELERATION OF EVA CURRENT FARE STATION WAGON
40% DEPTH OF DISCHARGE
KM/HR/SEC
MI/HR/SEC
VELOCITY (KM/HR)
VELOCITY (MI/HR)
15
10
5
0
-5
-10
9
8
7
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
0
10
20
30
40
50
60
70
80
90
100
110
120
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75

b. 40%


ACCELERATION OF EVA CURRENT FARE STATION WAGON
80% DEPTH OF DISCHARGE
KM/HR/SEC
MI/HR/SEC
VELOCITY (KM/HR)
VELOCITY (MI/HR)
15
10
5
0
-5
-10
9
8
7
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
0 10 20 30 40 50 60 70 80 90 100 110 120
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75

c. 80%

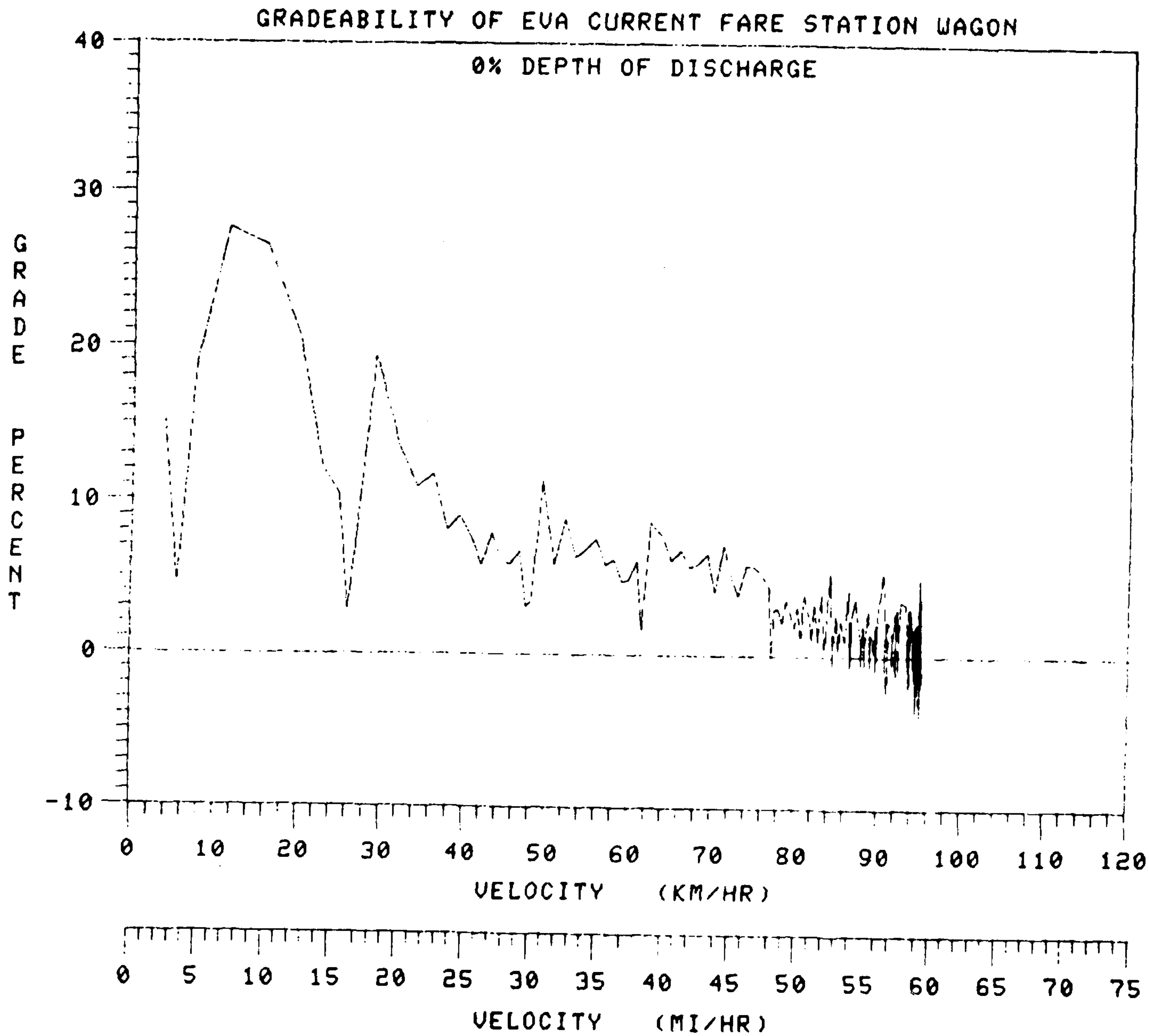
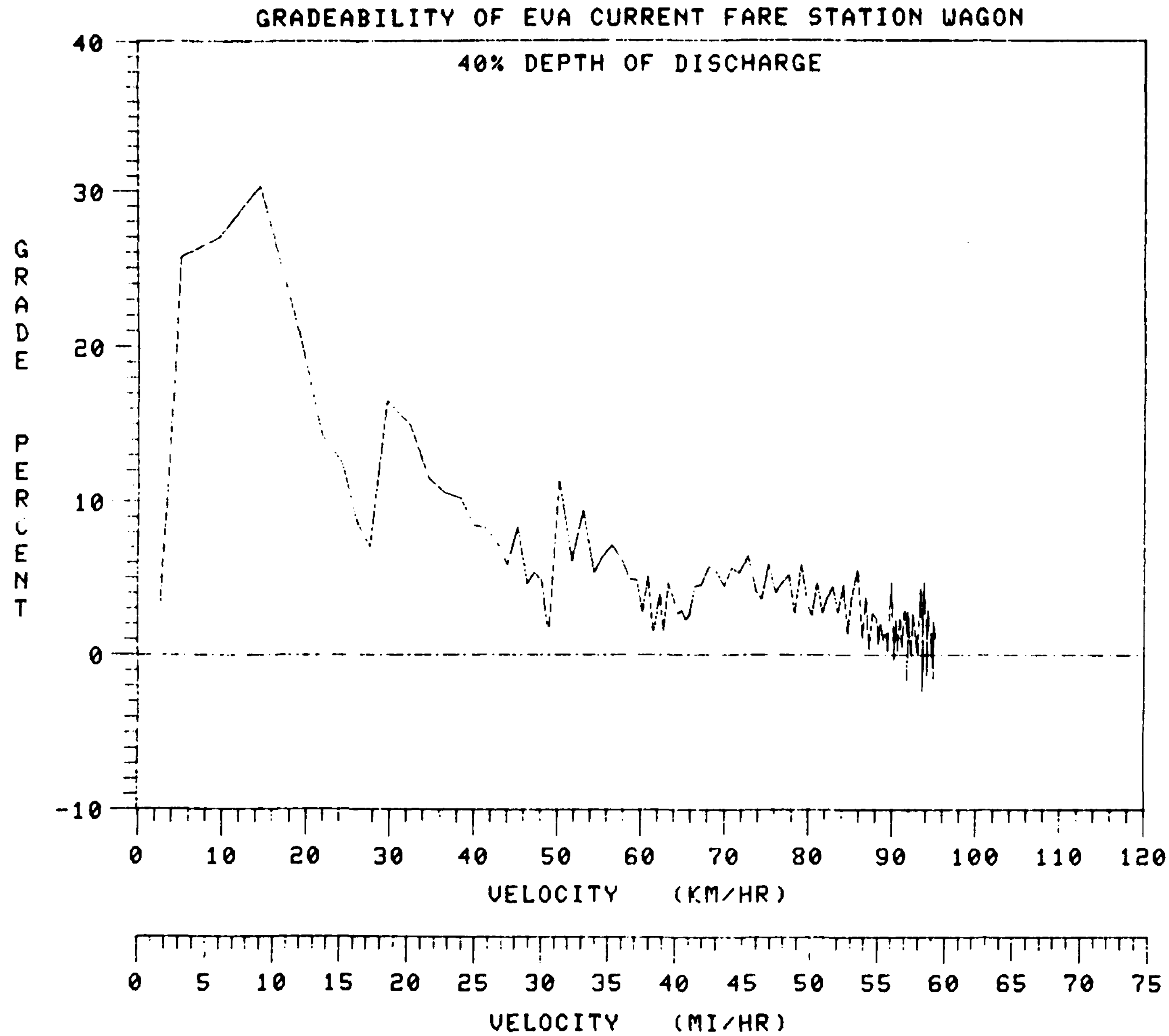
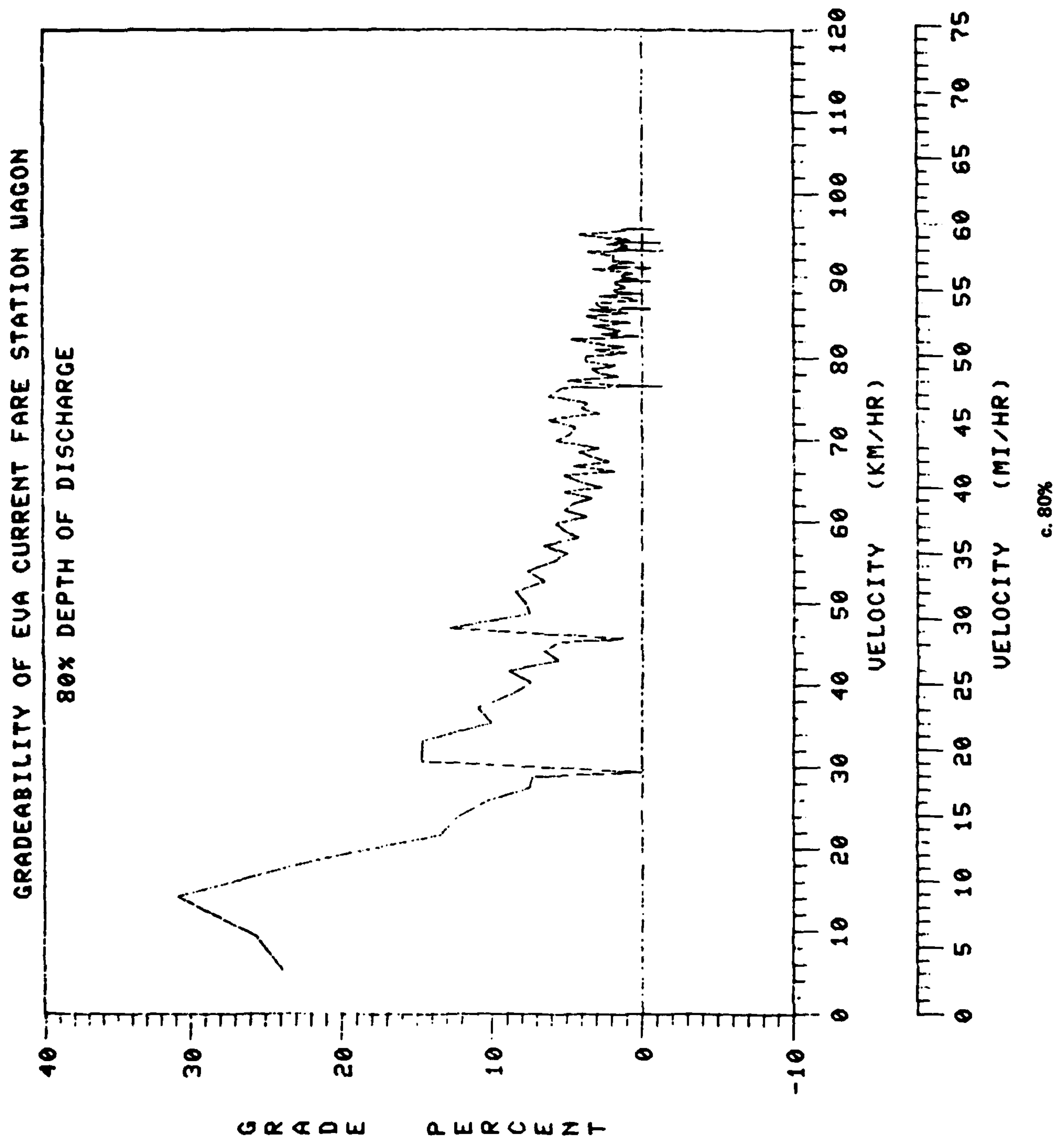


Figure 34. Gradeability of current fare wagon: a. 0% DOD.


GRADEABILITY OF EVA CURRENT FARE STATION WAGON
40% DEPTH OF DISCHARGE
GRADE PERCENT
40
30
20
10
0
-10
0 10 20 30 40 50 60 70 80 90 100 110 120
VELOCITY (KM/HR)
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75
VELOCITY (MI/HR)

b. 40%



GRADEABILITY OF EVA CURRENT FARE STATION WAGON
80% DEPTH OF DISCHARGE
GRADE PERCENT
40
30
20
10
0
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
VELOCITY (KM/HR)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
VELOCITY (MI/HR)
c.80%

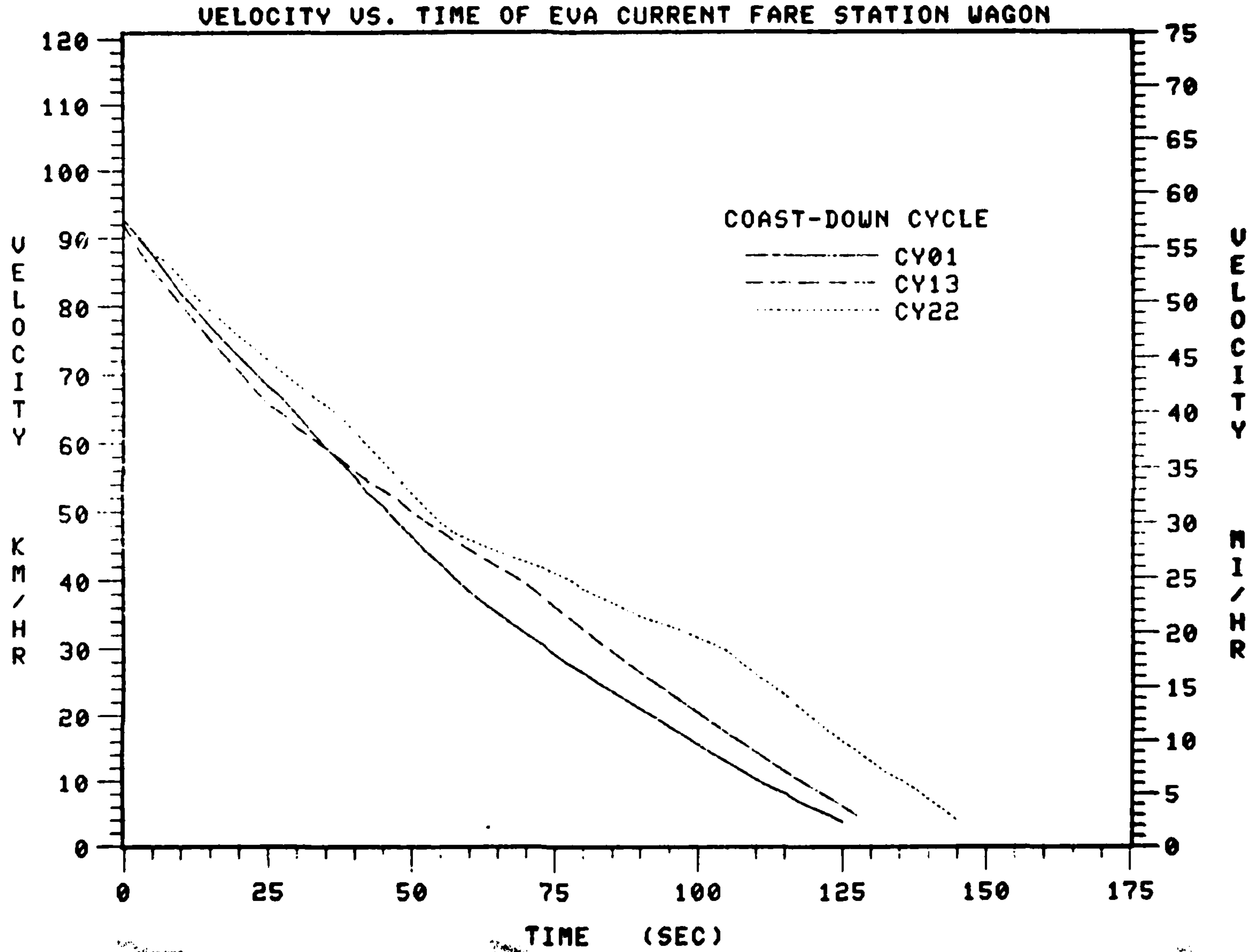


Figure 35. Coast-down test of current fare wagon.

- **Road Energy Consumption.** The road energy consumption of the Current Fare Wagon is shown in Figure 36.

- **Road Power.** The road power requirements for the Current Fare Wagon are shown in Figure 37. The data for the maximum acceleration and coast-down test figures are tabulated in Appendix C.

e. Gradeability Limit. The EVA Current Fare Wagon displayed the capability to negotiate a grade based on the results obtained at 0-, 40-, and 80-percent DOD (Table 3). The traction force data are given for first gear and reverse gear, as well as for the three states of discharge.

Table 3. Gradeability Limit Test Results

Gear	Tractive Force (lb)	Gradeability Limit (%)
0% DOD First	2685	64.4
Reverse	2614	61.9
40% DOD First	2595	61.4
Reverse*		
80% DOD First	1068	22.1
Reverse**	1040	21.4

* Did not complete pull; transmission noisy.

** Calculated from gear ratios.

f. Indicated Energy Economy. The SAE J227a test procedure defines energy economy as "the vehicle range in various operating modes divided into the a.c. energy required to return the battery to its original state of charge." Electrical power transfer was monitored at three points. A rotating Watt-hour meter measured the 60 Hz a.c. energy input to the charger. A Hall-effect device measured the energy out of the battery. See Table 2 for a.c. charger energy and net d.c. energy from the propulsion battery.

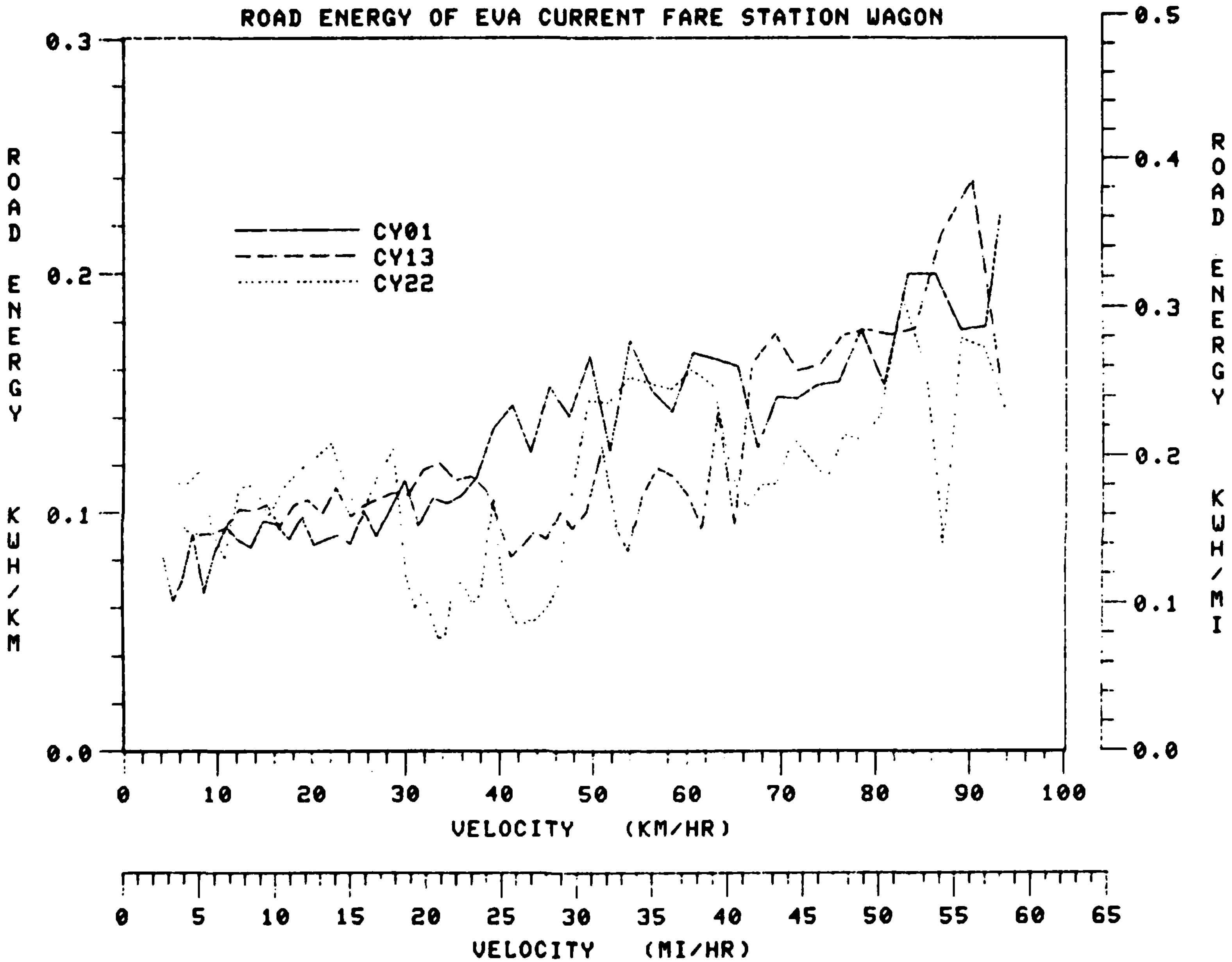


Figure 36. Road energy of current fare wagon.

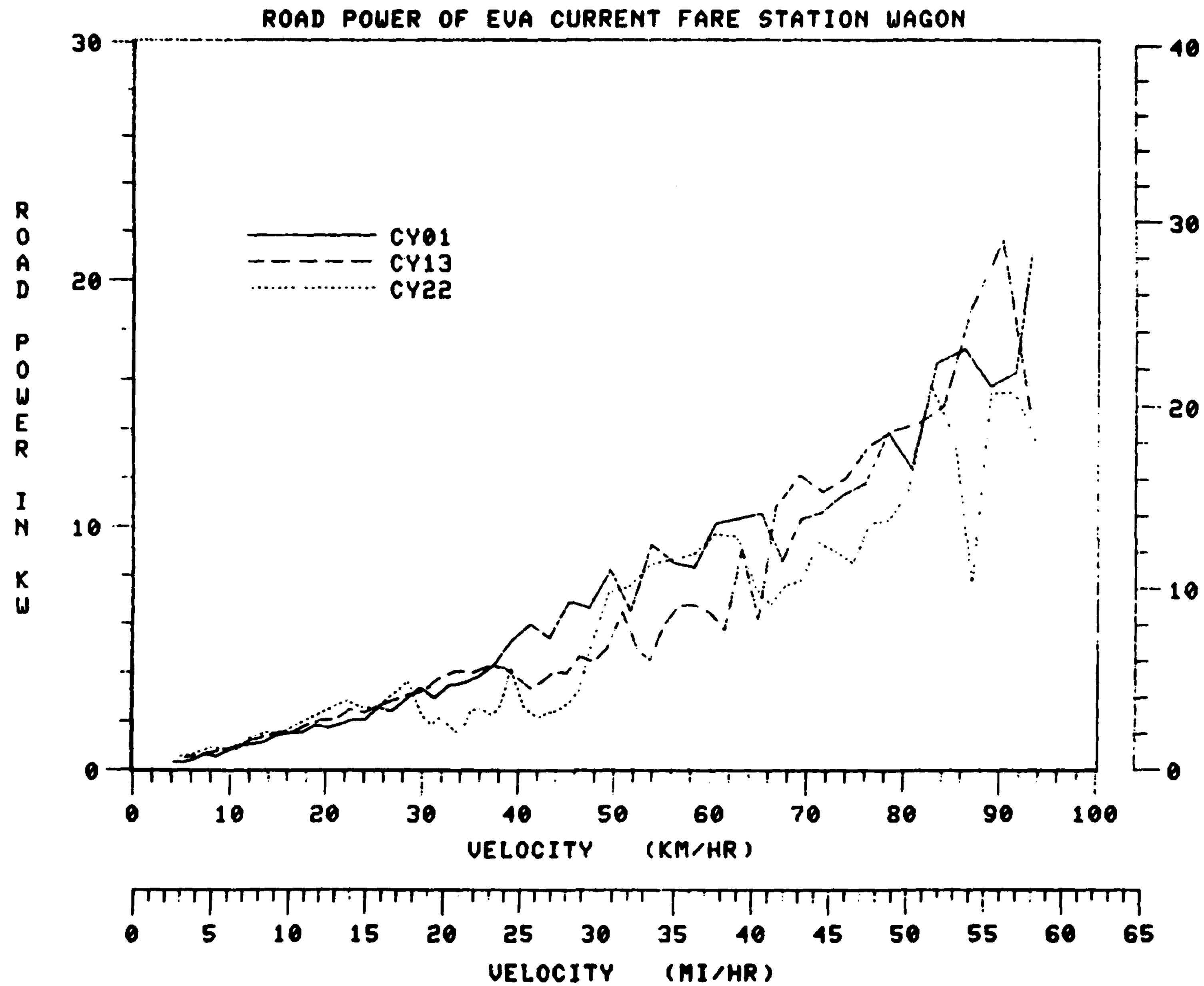


Figure 37. Road power of current fare wagon.

VIII. COMPONENT PERFORMANCE AND EFFICIENCY

a. Battery Charger. The first vehicle delivered to MERADCOM had an integral on-board battery charger. This was an EVA Mk-VI Battery Marshall, which utilized 110 V or 230 V a.c. Subsequent vehicles were equipped with an off-board Ferro-resonant 220-V a.c., 30-A unit with automatic turn-off. All tests were performed with this charger.

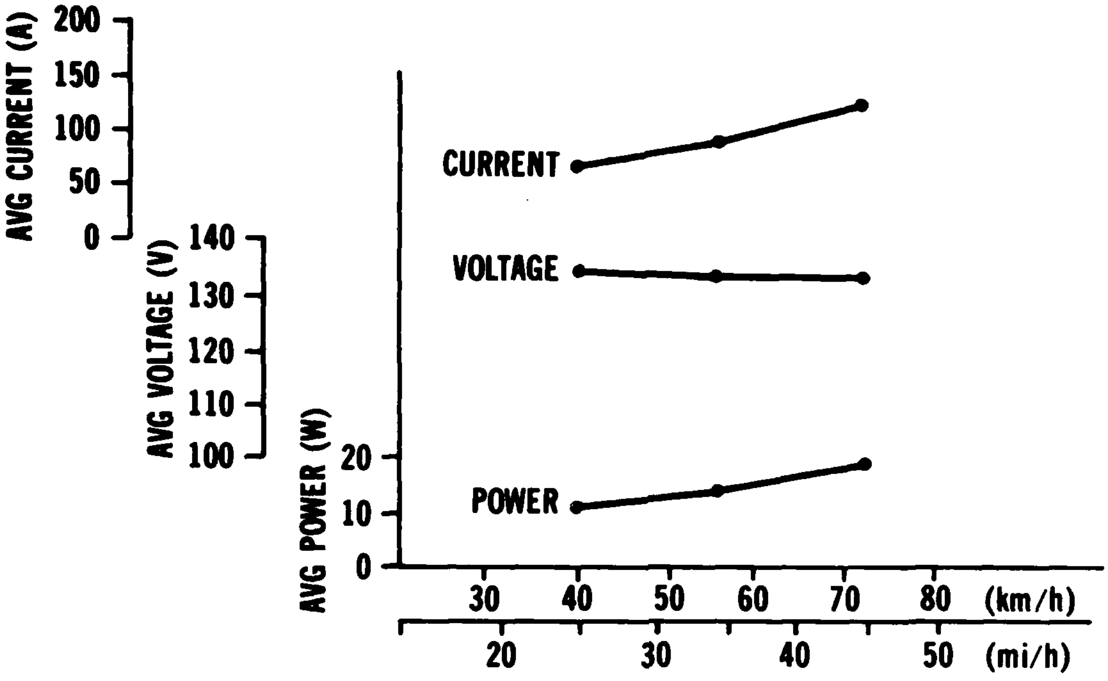
b. Battery Characteristics. The Current Fare Wagon uses 22 6-V Exide XPV23-3 batteries connected in series. (See Section IX.) Standard discharges (75-A constant-current discharge to 1.75-V cell) yielded 119 min discharge time (95 percent of the 125-min rating), indicating that the battery pack capacity was well within the 80 percent required for testing.

The constant speed battery performance is given in Figure 38.

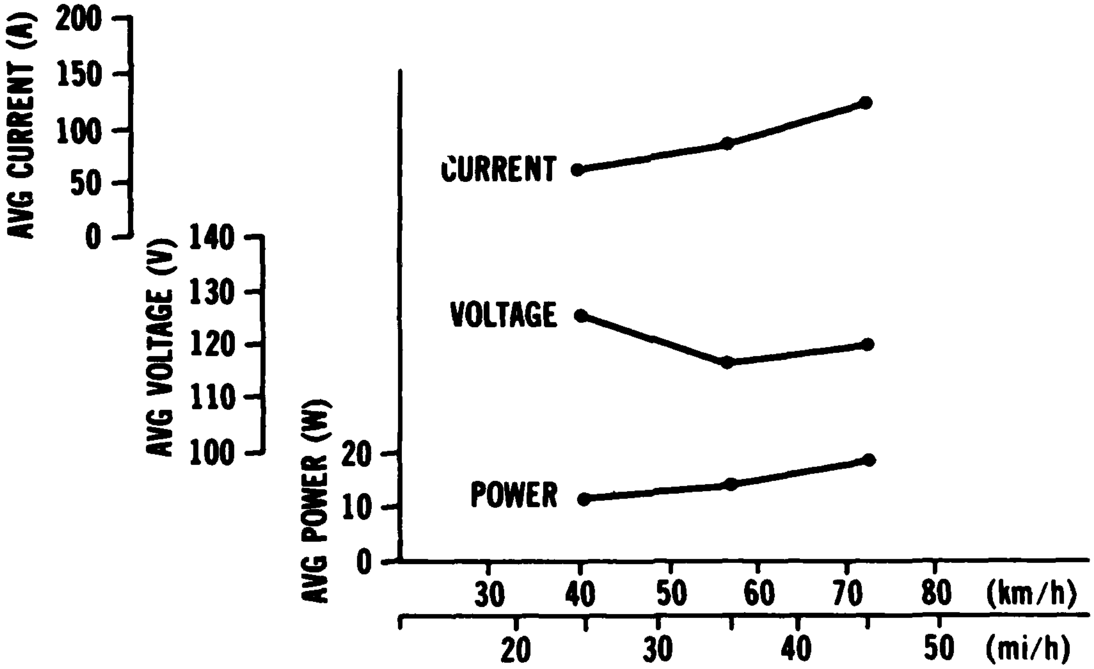
IX. RELIABILITY

The first EVA Current Fare Wagon was delivered to MERADCOM on 27 March 1980. On 10 April, while the vehicle was being driven at MERADCOM, some difficulty was experienced with the automatic transmission. The problem appeared to be low oil pressure to the transmission at lower speeds. The oil pump to the transmission was belt-driven by the traction motor. On 2 May, the vehicle was returned to the manufacturer. On 21 August, the vehicle was again delivered to MERADCOM. The oil pump used to maintain pressure to the transmission had been changed. It was driven by an electric motor powered by the 12-V auxiliary battery. On 25 September, while the vehicle manufacturer was performing acceleration tests with the vehicle, a loud noise was heard coming from the transmission area. The vehicle manufacturer recommended testing be terminated and the vehicle returned for repairs.

On 3 November 1980, a second vehicle was delivered to MERADCOM from Electric Vehicle Associates. This was equipped as was the first one except that it had a manually operated 4-speed transmission and the batteries were interconnected with spring-loaded quick-disconnect cables. While undergoing testing, the spring-loaded connectors had a tendency to work up and off the tapered battery posts. In early January 1981, a representative of EVA arrived and changed all the spring-loaded cables to the standard bolted battery post connectors. Testing continued; however, the vehicle performance was not as good as the manufacturer expected. After some discussion, it was decided to replace the battery pack. The original batteries were Varta P-125s. In June 1981, the entire pack was replaced with Exide XPV 23-3s, and all data in this report are based on testing performed with these batteries.



a. FIRST 25% OF RANGE



b. LAST 25% OF RANGE

Figure 38. Constant speed battery performance.

X. VERIFICATION TEST RESULTS

The EVA Current Fare Wagon was also tested under the DOE Market Demonstration Program, which establishes criteria for Self-Certification and Verification Procedures for Electric and Hybrid Vehicles (Appendix D). The following are the results of verification test results performed at MERADCOM (paragraphs are referenced to the DOE "Performance Standards for Demonstrations" as published in the Federal Register, 12 February 1980, Part IV):

475.10:

a. Acceleration: 0-50 km/h (31.1 mi/h) in 9.6 s.

b. Gradeability at Speed: At 25 km/h (15 mi/h) the vehicle can traverse a 14.6-percent grade based on calculation from acceleration tests.

c. Gradeability Limit: Calculations based on draw-bar pull test indicate a 22.1-percent forward and a 21.4-percent reverse gradeabillity for at least 20 s.

d. Forward Speed Capability: Forward speed of 80 km/h (50 mi/h) was maintained for more than 5 min on the level (± 1-percent grade) portion of the MERADCOM test track.

e. Range: SAE J227a Cycle C on level (± 1-percent) terrain yielded 74.3 km (46.2 mi) and 129 cycles.

f. Battery Recharge Time: After an 80-percent discharge, recharged with off-board charger (30 A, 240 V) for 10 h. After recharge, the vehicle yielded 76.1 km (47.3 mi) and 140 cycles.

g. Recharge Control: Current limit, voltage comparator.

h. Energy Consumption: The vehicle uses only electrical energy except for the comfort heater, which is a gasoline-fired unit. (See paragraph 1 below.)

i. Battery:

(1) Warranty: Unconditional 180 days, prorated remainder of year by battery manufacturer. A one-year umbrella warranty by Vehicle Manufacturer.

(2) Type: Lead acid, Exide XPV 23-3.

(3) Capacity: 156 Ah (125 min at 75-A rate).

(4) Voltage: 132-V (22 6-V modules connected in series).

j. State-of-Charge Meter: The vehicle is equipped with a state-of-charge meter of the loaded-voltmeter type.

k. Odometer: The vehicle is equipped with an odometer.

l. Passenger Comfort Heater: Gasoline-fired unit manufactured by Espar and rated at 8000 Btu.

m. Documentation: Operations manual, maintenance manual, and electrical schematics were submitted with the vehicle.

n. Emissions: Did not evaluate.

o. Safety, etc.: The Department of Transportation (DOT) is performing these evaluations. MERADCOM performed the following checks for design intent:

(1) Electrical Isolation: The electrical propulsion system is isolated from the vehicle chassis.

(2) Safety Standards 208 and 301: DOT will check compliance.

(3) Battery Caps: Standard golf-cart industry type. Flame barrier characteristics were not checked.

(4) Ventilation of Battery Compartment: The front upper battery compartment and the rear battery compartment are both vented by axial fans (1 each) rated at 100 ft^3/min. These fans operate while charging and during normal vehicle operation and are sufficient to change the air 80 times/min in the front and 35 times/min in the rear. The front lower compartment is not fan vented; however, it is exposed to the air passing through the grill while the vehicle is operating.

(5) Battery Emergency Disconnect: None. However, this vehicle is equipped with a manual transmission, and the propulsion system can be disconnected from the mechanical drive system by depressing the clutch. The battery system is also fused in case of excessive current.

(6) Parked Temperature Effect: The vehicle was parked for 8 h at each of the temperatures, -25° C and +50° C. Subsequent operation at each of those temperatures revealed no damage to the vehicle or hazard to personnel.

APPENDIX A

VEHICLE SUMMARY DATA SHEET

1. Vehicle Manufacturer Name and Address:

Lectra Motors Corp.
5380 S. Valley View Boulevard
Las Vegas, Nevada 89118
702/736-4915

2. Vehicle Description:

Name: Current Fare Wagon
Model: Station Wagon
Availability: 120 days
Price: $15,993.00

3. Vehicle Weight:

Curb Wt: 1909.6 kg (4210 lb)
Passenger Wt: 204 kg (450 lb)
Driver Wt: 68 kg (150 lb)
Payload Wt: 68 kg (150 lb)
Gross Wt: 2250 kg (4960 lb)

4. Vehicle Size:

Wheelbase: 2.7 m (105.5 in.)
Length: 4.9 m (195.5 in.)
Width: 1.8 m (71 in.)
Headroom: 1 m (39 in.)
Legroom: 1.05 m (41.7 in.)

5. Auxiliaries and Options:

Lights: No.: 12
Type and Function:

a. Headlights: 2

b. Taillights: 2

c. Directionals: 4

d. Warning: 4

Windshield Wipers: Yes.
Windshield Washers: Yes.
Defroster: Yes.
Heater: Yes.
Radio: No.
Fuel Gage: Yes.
Ammeter: Yes.
Tachometer: No.
Speedometer: Yes.
Odometer: Yes.
No. of Mirrors: 2.
Power Steering: No.
Power Brakes: No.
Transmission Type: Standard 4-speed manual.

a. 1st gear ratio, 4.07:1

b. 2nd gear ratio, 2.57:1

c. 3rd gear ratio, 1.66:1

d. 4th gear ratio, 1.00:1

e. Reverse gear, 3.95:1.

6. Propulsion Batteries:

Type: Lead-Acid
Manufacturer: Exide
No. of Modules: 22
Model: XPV 23-3
No. of Cells: 66
Battery Voltage: 132 V
Ah Capacity: 165 Ah
Battery Size: .25 m x .24 m x .18 m
(10 in. x 9.5 in. x 7 in.)

Battery Weight: 30 kg (66 lb)
Battery Rate: 75 A for 125 min.
Battery Cycles: 300 minimum

7. **Auxiliary Battery:**

Type: Lead Acid
Manufacturer: Fomoco
No. of Cells: 6
Battery Voltage: 12 V
Ah Capacity: 45
Battery Size: .18 m x .15 m x .20 m
(7.25 in. x 6 in. x 8 in.)
Battery Weight: 9 kg (20 lb)
Battery Rate: 20 hr

8. **Controller:**

Type: Pulsomatic Mark 10 S.C.R.
Manufacturer: Cableform
Voltage Rating: 144 V
Current Rating: 340 A
Size: .3 m x .25 m x .91 m
(12 in. x 10 in. x 36 in.)
Weight: 27.2 kg (60 lb)

9. **Propulsion Motor:**

Type: Series
Manufacturer: Reliance
Insulation Class: H
Voltage Rating: 120 V
Current Rating: 200 A
HP Rating: 30 hp
Weight: 100 kg (220 lb)
Size: .3 m D x .45 m L
(12 in. D x 18 in. L)
Rated Speed: 3,000 r/min

10. Body:

Type: Unitized
Manufacturer: Ford
No. of doors: 5
Type: 4 swing, 1 hatch
No. of windows: 8
Type: 4 fixed, 4 wind-down
No. of seats: 4
Type: 2 bucket, 1 bench
Cargo volume: 2.25 m^3 (79.5 ft^3)
Cargo Dimensions: 1.14 m x .73 m x 2.07 m
(45 in. x 28.8 in. x 81.7 in.)

11. Chassis:

Type Frame: Standard Ford Fairmont
Manufacturer: Ford
Type Material: Steel
Modifications: Battery Retention
Stiffeners
Type Springs: Coil
Type Shocks: Hydraulic
Axle Type (front): Standard Ford
Axle Type (rear): Hotchkiss
Axle Manufacturer: Ford
Drive Line Ratio: 3.44:1
Type Brakes (front): Disc
Type Brakes (rear): Drum
Regenerative Brakes: Yes
Tire Type: Radials
Manufacturer: Firestone
Size: P-185/75R14
Pressure: 241.3 kPa (35 lb/in.^{2})
Rolling Radius: .31 m (1.022 ft)

12. Battery Charger:

Type: Ferro-Resonant
Manufacturer: DC Systems, Inc.
On- or Off-Board: Off-Board

Input Voltage: 240 V a.c.
Peak Current: 30 A
Recharger Timer: Yes
Size: .42 m x .23 m x .38 m
(16.8 in. x 9.4 in. x 15.25 in.)
Weight: 61.2 kg (135 lb)
Automatic Turn-Off: Yes

APPENDIX B

DRIVING CYCLE DATA

B-CYCLE				CYCLE 3	B-CYCLE				CYCLE 3
ELAPSED TIME (SEC)	VELOCITY (MI/HR)	VOLTAGE (VOLTS)	CURRENT (AMPS)	POWER (KW)	ELAPSED TIME (SEC)	VELOCITY (MI/HR)	VOLTAGE (VOLTS)	CURRENT (AMPS)	POWER (KW)
.50	.42	141.63	17.94	2.2064	23.00	20.06	138.10	38.69	5.0646
1.00	.51	139.88	35.02	4.5628	23.50	19.95	138.28	38.49	5.1194
1.50	1.46	140.10	36.72	5.3127	24.00	19.90	138.48	38.43	5.2752
2.00	2.30	139.14	41.72	5.6184	24.50	19.79	138.12	39.16	5.1021
2.50	2.90	139.45	40.56	5.5578	25.00	19.66	138.70	38.34	5.2867
3.00	3.49	139.61	39.75	5.5636	25.50	19.61	138.42	38.84	5.2896
3.50	3.89	138.92	44.20	5.8434	26.00	19.44	138.18	39.87	5.2377
4.00	4.22	139.39	43.31	6.1295	26.50	19.35	138.61	40.42	5.6247
4.50	4.71	138.77	50.96	6.0712	27.00	19.30	137.08	55.11	7.0720
5.00	4.98	139.02	38.19	5.9270	27.50	19.21	136.67	63.45	8.5747
5.50	5.30	139.72	41.19	5.8664	28.00	19.27	136.40	67.39	9.0563
6.00	5.61	138.56	49.70	5.6732	28.50	19.32	135.55	75.67	9.9562
6.50	5.93	137.63	63.74	6.0959	29.00	19.43	135.77	78.37	10.5013
7.00	6.54	135.05	101.55	13.2557	29.50	19.56	135.42	72.55	10.3975
7.50	7.33	134.58	100.89	13.5326	30.00	19.60	135.50	77.20	10.2446
8.00	8.20	135.39	93.77	12.9327	30.50	19.76	135.83	76.40	10.2283
8.50	8.98	135.28	89.76	12.0732	31.00	19.98	135.45	75.82	10.1404
9.00	9.53	135.49	87.49	11.6809	31.50	19.95	135.88	74.11	10.1177
9.50	10.05	135.82	83.40	11.3781	32.00	20.12	135.86	72.80	9.9447
10.00	10.45	135.54	80.55	10.6253	32.50	20.18	135.99	68.20	9.2150
10.50	10.72	136.17	76.81	10.4754	33.00	20.21	136.63	65.06	9.0304
11.00	11.17	136.09	75.28	10.0831	33.50	20.27	136.29	64.37	8.5487
11.50	11.44	135.95	73.15	9.7745	34.00	20.27	136.43	64.08	8.7215
12.00	11.63	136.82	67.64	9.4947	34.50	20.35	136.79	63.29	8.7189
12.50	11.69	136.74	61.84	8.3064	35.00	20.37	136.39	63.77	8.4160
13.00	11.54	136.43	70.01	9.0217	35.50	20.39	136.69	63.00	8.5603
13.50	11.98	133.43	116.84	14.9776	36.00	20.47	136.52	63.17	8.4420
14.00	12.70	131.91	131.69	17.4608	36.50	20.44	136.43	63.39	8.4132
14.50	13.33	132.32	132.43	18.0435	37.00	20.47	136.90	62.45	8.5747
15.00	13.98	132.22	130.13	17.4291	37.50	20.51	136.44	63.05	8.4449
15.50	14.49	132.29	126.67	16.9302	38.00	20.52	136.60	62.41	8.3757
16.00	15.01	132.93	121.25	16.3591	38.50	20.60	136.81	61.80	8.4391
16.50	15.44	132.53	117.90	15.4650	39.00	20.62	136.52	62.66	8.2891
17.00	15.85	130.79	153.48	18.9087	39.50	20.63	139.93	21.21	4.2859
17.50	16.47	129.03	181.39	23.0921	40.00	20.55	141.60	1.72	.2509
18.00	17.08	128.94	177.08	22.4736	40.50	20.30	141.68	1.83	.1817
18.50	17.74	129.76	169.70	21.8967	41.00	20.11	142.21	1.17	.3865
19.00	18.44	128.98	176.03	21.7323	41.50	19.92	141.93	2.16	.2250
19.50	18.93	128.55	183.24	22.9610	42.00	19.70	142.18	1.56	.3115
20.00	19.67	130.10	162.12	21.5420	42.50	19.50	142.14	1.80	.2826
20.50	20.21	135.25	70.52	10.5417	43.00	19.26	142.02	2.19	.2798
21.00	20.37	137.57	45.21	6.4346	43.50	19.08	142.58	1.20	.4528
21.50	20.36	137.94	39.88	5.4194	44.00	18.87	142.27	1.50	1.6382
22.00	20.23	138.03	39.27	5.1656	44.50	18.29	147.06	-34.65	5.8780
22.50	20.12	138.55	37.99	5.3155	45.00	17.21	149.07	-38.43	6.4317

B-CYCLE

CYCLE 3

ELAPSED TIME (SEC)	VELOCITY (MI/HR)	VOLTAGE (VOLTS)	CURRENT (AMPS)	POWER (KW)
45.50	15.86	148.95	-32.58	5.8520
46.00	14.52	149.09	-32.10	5.8001
46.50	13.21	148.37	-29.62	5.6328
47.00	11.88	147.14	-24.50	4.6176
47.50	10.45	146.78	-21.41	4.2599
48.00	8.65	144.94	-12.74	2.7630
48.50	6.05	143.65	-4.01	1.1739
49.00	2.93	143.14	1.35	.3173
49.50	.70	142.85	1.21	.1211
50.00	.07	143.04	.59	.1961

B-CYCLE				CYCLE N-1
ELAPSED TIME (SEC)	VELOCITY (MI/HR)	VOLTAGE (VOLTS)	CURRENT (AMPS)	POWER (KW)
.50	1.21	136.47	4.65	.5393
1.00	.21	138.08	9.45	1.1594
1.50	.57	135.61	32.29	3.9513
2.00	1.45	134.66	46.05	6.1693
2.50	2.57	134.39	48.47	6.6769
3.00	3.45	134.36	46.03	5.9616
3.50	4.14	135.08	43.03	5.6040
4.00	4.63	134.97	37.13	5.3271
4.50	5.05	134.64	42.49	5.0675
5.00	5.36	135.52	30.87	4.9031
5.50	5.59	134.73	39.65	4.7329
6.00	5.80	135.65	30.10	4.8079
6.50	6.14	134.93	37.73	4.9377
7.00	6.40	134.64	38.73	5.0877
7.50	6.70	133.95	53.84	6.8499
8.00	7.09	133.06	60.17	7.7902
8.50	7.50	133.39	56.23	7.5450
9.00	7.94	133.50	54.71	7.2422
9.50	8.27	133.23	53.45	6.8586
10.00	8.54	133.81	50.84	6.9653
10.50	8.80	133.66	50.82	6.7461
11.00	8.98	133.62	50.33	6.7432
11.50	9.19	134.11	48.13	6.4865
12.00	9.20	133.39	44.68	6.0424
12.50	9.22	131.68	76.70	6.8141
13.00	9.85	126.19	153.67	17.6483
13.50	10.83	123.30	182.93	22.0957
14.00	11.88	124.81	170.67	21.2449
14.50	12.85	125.37	159.89	19.3361
15.00	13.61	126.26	145.64	17.8012
15.50	14.40	125.15	166.67	19.5894
16.00	15.16	124.09	176.73	21.2132
16.50	15.91	124.88	166.06	20.0422
17.00	16.70	125.41	156.23	18.8279
17.50	17.30	125.80	148.89	17.8819
18.00	17.93	126.04	152.13	18.3751
18.50	18.53	125.23	157.36	18.5251
19.00	19.05	124.90	163.19	19.0991
19.50	19.69	125.42	157.83	18.8597
20.00	20.22	129.54	94.72	13.2961
20.50	20.49	133.04	58.59	7.2220
21.00	20.60	132.90	52.14	6.8471
21.50	20.57	133.11	51.28	6.6682
22.00	20.60	133.50	48.30	6.6942
22.50	20.65	133.45	45.98	6.3192

B-CYCLE				CYCLE N-1
ELAPSED TIME (SEC)	VELOCITY (MI/HR)	VOLTAGE (VOLTS)	CURRENT (AMPS)	POWER (KW)
23.00	20.62	133.71	44.31	6.1981
23.50	20.65	134.00	42.55	5.8866
24.00	20.62	133.90	42.71	5.7972
24.50	20.59	134.25	41.80	5.8145
25.00	20.59	134.02	42.27	5.6213
25.50	20.54	133.92	41.36	5.3761
26.00	20.55	134.39	40.20	5.5492
26.50	20.51	134.05	41.32	5.3877
27.00	20.42	134.26	40.63	5.3675
27.50	20.44	134.27	40.77	5.4655
28.00	20.44	134.07	41.31	5.3963
28.50	20.38	134.47	40.28	5.5549
29.00	20.32	134.05	41.62	5.3675
29.50	20.27	134.21	41.09	5.4771
30.00	20.27	134.52	40.35	5.5203
30.50	20.34	134.23	40.79	5.5232
31.00	20.33	134.34	40.12	5.3444
31.50	20.24	134.22	40.57	5.2838
32.00	20.15	134.25	40.36	5.3617
32.50	20.14	134.59	39.92	5.5953
33.00	20.13	134.22	40.41	5.3559
33.50	20.04	134.28	40.87	5.5722
34.00	20.06	133.95	44.58	5.9645
34.50	20.07	133.45	50.25	6.5038
35.00	20.03	133.26	54.60	7.0432
35.50	20.06	132.44	61.68	7.7585
36.00	20.09	131.97	66.84	8.6956
36.50	20.20	131.93	69.98	9.1948
37.00	20.37	131.46	74.73	9.6620
37.50	20.47	131.23	76.66	9.8524
38.00	20.65	131.25	76.65	9.9677
38.50	20.77	136.10	15.32	3.2707
39.00	20.72	137.48	6.07	1.0210
39.50	20.59	137.48	6.71	.8681
40.00	20.43	137.42	6.65	.7903
40.50	20.35	137.73	6.16	.8220
41.00	20.16	137.61	6.83	.7326
41.50	19.93	137.80	6.35	.8451
42.00	19.81	137.76	6.55	.7326
42.50	19.63	137.97	-.30	2.2872
43.00	19.03	141.40	-45.43	6.9278
43.50	17.78	141.44	-45.02	7.8450
44.00	16.31	141.33	-40.66	7.2681
44.50	14.92	141.10	-34.61	6.5586
45.00	13.53	140.80	-32.78	5.7741

B-CYCLE

CYCLE N-1

ELAPSED TIME (SEC)	VELOCITY (MI/HR)	VOLTAGE (VOLTS)	CURRENT (AMPS)	POWER (KW)
45.50	12.15	140.74	-30.93	5.4367
46.00	10.77	140.21	-22.30	3.9340
46.50	9.34	139.94	-18.15	3.5418
47.00	7.65	139.50	-11.42	2.1891
47.50	5.61	138.78	-4.63	.9518
48.00	3.09	138.41	2.08	.1529

C-CYCLE CYCLE 3

ELAPSED TIME (SEC)	VELOCITY (MI/HR)	VOLTAGE (VOLTS)	CURRENT (AMPS)	POWER (KW)
.50	1.30	135.72	72.51	9.5582
1.00	3.44	131.77	136.98	17.7464
1.50	5.23	130.20	152.52	20.2700
2.00	6.94	130.42	144.58	19.9759
2.50	8.34	131.55	127.35	17.5531
3.00	9.39	131.95	115.61	15.4361
3.50	10.23	132.56	106.86	14.3315
4.00	10.96	132.70	101.33	13.5730
4.50	11.55	132.81	97.61	12.9010
5.00	12.00	134.00	83.53	11.7127
5.50	12.11	134.06	77.23	10.1293
6.00	12.47	127.42	188.01	21.2651
6.50	13.65	123.92	244.42	30.5262
7.00	14.96	123.14	251.11	30.8983
7.50	16.24	121.11	287.93	34.8409
8.00	17.62	120.23	296.47	35.8331
8.50	18.87	121.86	265.55	32.9633
9.00	20.02	124.14	227.92	28.6255
9.50	20.94	126.49	182.44	23.5263
10.00	21.57	129.19	138.21	18.6751
10.50	21.90	132.06	94.52	12.9298
11.00	21.97	129.67	135.58	14.8276
11.50	22.48	120.58	291.40	34.1949
12.00	23.53	120.08	294.38	35.6024
12.50	24.52	121.61	264.38	33.0470
13.00	25.42	125.08	205.22	27.1430
13.50	25.99	126.25	181.15	23.4426
14.00	26.51	126.69	176.27	22.8197
14.50	27.13	127.06	168.45	22.0207
15.00	27.49	127.39	162.57	21.0026
15.50	27.89	126.17	189.65	23.3734
16.00	28.40	123.52	229.50	27.9939
16.50	28.98	120.42	286.70	33.3787
17.00	29.76	119.94	295.75	35.5043
17.50	30.43	130.40	109.77	17.7377
18.00	30.70	133.64	64.99	9.2005
18.50	30.75	134.41	56.04	7.5652
19.00	30.70	134.50	56.01	7.4124
19.50	30.64	135.00	54.26	7.4268
20.00	30.60	134.81	55.02	7.3518
20.50	30.51	134.94	54.68	7.3662
21.00	30.52	135.08	53.94	7.4498
21.50	30.49	134.98	54.78	7.3172
22.00	30.38	135.19	53.94	7.3345
22.50	30.43	135.08	54.52	7.3777

C-CYCLE CYCLE 3

ELAPSED TIME (SEC)	VELOCITY (MI/HR)	VOLTAGE (VOLTS)	CURRENT (AMPS)	POWER (KW)
23.00	30.42	135.03	54.62	7.2854
23.50	30.36	135.27	53.97	7.4181
24.00	30.27	135.08	54.87	7.3460
24.50	30.17	135.22	54.26	7.3316
25.00	30.16	135.16	54.70	7.3893
25.50	30.13	135.14	54.66	7.3922
26.00	30.14	135.37	54.67	7.5133
26.50	30.13	135.08	56.37	7.6056
27.00	30.08	134.56	62.78	8.4535
27.50	30.09	133.93	75.27	9.9014
28.00	30.15	133.36	80.50	10.6224
28.50	30.22	133.43	80.94	10.8243
29.00	30.28	133.50	78.85	10.5878
29.50	30.36	133.87	71.49	9.5841
30.00	30.44	134.36	67.70	9.3563
30.50	30.48	134.56	62.30	8.5603
31.00	30.47	134.77	58.69	7.3998
31.50	30.48	135.09	56.55	7.7469
32.00	30.46	135.49	51.09	6.9913
32.50	30.38	136.11	44.46	6.0251
33.00	30.33	136.24	42.63	5.7655
33.50	30.22	136.28	42.23	5.5751
34.00	30.15	136.58	41.27	5.7020
34.50	30.06	136.45	41.95	5.6501
35.00	29.95	136.40	41.75	5.5694
35.50	29.91	136.66	40.66	5.5347
36.00	29.83	136.71	39.66	5.3386
36.50	29.73	136.92	38.21	5.2146
37.00	29.61	136.74	38.30	5.1396
37.50	29.49	136.70	38.73	5.1021
38.00	29.44	136.96	36.95	5.1858
38.50	29.33	139.75	2.74	.9143
39.00	29.14	140.10	1.35	.1586
39.50	28.98	140.21	1.72	.2105
40.00	28.81	140.23	1.94	.1702
40.50	28.63	140.39	1.53	.2538
41.00	28.47	140.43	1.71	.2480
41.50	28.26	140.32	1.90	.1500
42.00	28.09	140.48	1.65	.2019
42.50	27.95	140.5[illegible]	1.70	.1932
43.00	27.72	140.61	1.60	.2596
43.50	27.54	140.57	1.83	.2134
44.00	27.38	140.65	1.77	.1557
44.50	27.19	140.81	1.23	.2509
45.00	27.01	140.43	5.64	.4384

C-CYCLE

CYCLE 3

ELAPSED TIME (SEC)	VELOCITY (MI/HR)	VOLTAGE (VOLTS)	CURRENT (AMPS)	POWER (KW)
45.50	26.69	143.02	-23.46	5.9472
46.00	25.77	144.62	-35.02	5.9501
46.50	23.78	144.32	-30.96	5.7482
47.00	20.58	143.86	-27.17	7.0749
47.50	16.87	143.19	-18.04	8.0699
48.00	13.48	142.59	-14.35	6.3885
48.50	10.68	142.10	-7.83	4.3320
49.00	8.96	141.38	.36	.2048
49.50	7.78	141.16	.41	.0087
50.00	6.86	141.29	.30	.0692
50.50	6.19	141.22	.60	.0317
51.00	5.40	141.29	.09	.1240
51.50	4.56	141.23	.47	.0606
52.00	3.76	141.17	.69	-.0087
52.50	3.07	141.24	.27	.0288
53.00	2.30	141.31	.46	.0288
53.50	1.50	141.27	.22	.0663
54.00	.74	141.26	.42	.0144

C-CYCLE CYCLE N-1

ELAPSED TIME (SEC)	VELOCITY (MI/HR)	VOLTAGE (VOLTS)	CURRENT (AMPS)	POWER (KW)
.50	.90	119.60	28.11	2.9563
1.00	.96	114.69	57.83	5.5434
1.50	2.18	107.54	102.60	9.0535
2.00	3.65	100.29	148.54	13.3134
2.50	5.23	98.04	153.77	13.6797
3.00	6.63	96.43	161.23	14.0517
3.50	7.92	91.43	192.84	16.2293
4.00	9.11	89.74	195.81	16.4341
4.50	10.28	89.98	191.36	16.3937
5.00	11.38	99.78	188.24	16.1572
5.50	12.33	93.07	157.02	14.4613
6.00	13.01	101.13	97.50	9.8697
6.50	13.13	97.23	128.27	10.7494
7.00	13.62	86.79	199.06	15.8919
7.50	14.69	85.75	198.71	15.9409
8.00	15.45	85.45	192.74	15.3266
8.50	16.17	86.09	186.09	15.1650
9.00	16.33	85.93	181.27	14.5824
9.50	17.42	86.17	176.12	14.3834
10.00	18.07	86.52	172.85	14.1037
10.50	18.58	86.19	168.83	13.6162
11.00	19.01	86.81	164.36	13.5557
11.50	19.52	86.75	161.56	13.2355
12.00	19.91	86.45	159.91	12.8779
12.50	20.36	87.06	155.02	12.9471
13.00	20.81	86.60	153.94	12.5779
13.50	21.16	86.99	150.50	12.3357
14.00	21.54	87.60	146.21	12.1537
14.50	21.62	90.20	129.57	11.0378
15.00	21.83	85.03	159.21	12.4972
15.50	22.39	83.85	161.12	12.6096
16.00	22.75	83.79	158.83	12.2607
16.50	23.09	84.27	156.05	12.3558
17.00	23.40	83.84	154.30	11.9694
17.50	23.69	84.23	152.29	12.1165
18.00	24.03	84.30	150.35	11.9607
18.50	24.27	83.86	150.03	11.7357
19.00	24.54	84.40	147.83	11.8598
19.50	24.84	84.15	146.90	11.6406
20.00	25.05	84.19	145.71	11.4127
20.50	25.38	84.58	143.58	11.5165
21.00	25.63	84.15	142.98	11.2743
21.50	25.88	84.47	141.83	11.3637
22.00	26.20	84.45	140.62	11.2858
22.50	26.35	84.13	140.23	10.9368

C-CYCLE CYCLE N-1

ELAPSED TIME (SEC)	VELOCITY (MI/HR)	VOLTAGE (VOLTS)	CURRENT (AMPS)	POWER (KW)
23.00	26.54	84.70	138.09	11.1618
23.50	26.75	84.29	137.96	10.9772
24.00	26.89	84.49	136.45	10.9397
24.50	27.11	84.69	135.64	10.9224
25.00	27.28	84.09	135.26	10.7176
25.50	27.48	84.79	133.63	10.8561
26.00	27.72	84.62	133.27	10.6715
26.50	27.81	84.49	132.79	10.6917
27.00	28.00	84.80	131.65	10.6253
27.50	28.17	84.28	131.45	10.3629
28.00	28.28	84.66	130.25	10.5100
28.50	28.49	84.83	129.55	10.4580
29.00	28.60	84.28	129.80	10.1581
29.50	28.69	84.80	128.18	10.4379
30.00	28.92	84.49	128.33	10.2100
30.50	28.87	84.50	127.73	10.1062
31.00	29.04	84.73	126.59	10.3081
31.50	29.20	84.35	126.75	9.9937
32.00	29.32	84.72	125.59	10.2619
32.50	29.49	84.67	125.38	10.1898
33.00	29.55	84.41	125.34	9.9274
33.50	29.68	84.88	123.92	10.0889
34.00	29.85	84.52	124.00	9.8206
34.50	29.92	84.68	123.29	9.9389
35.00	30.09	84.79	122.45	9.9072
35.50	30.22	84.41	122.70	9.6389
36.00	30.38	84.79	121.17	9.8206
36.50	30.52	84.69	120.86	9.6678
37.00	30.55	84.87	118.07	9.3563
37.50	30.67	85.63	115.27	9.4572
38.00	30.80	89.58	90.65	7.7844
38.50	30.85	90.93	86.83	7.4729
39.00	30.93	92.68	76.76	7.2683
39.50	30.90	108.14	1.08	.4730
40.00	30.81	110.90	-.17	-.1067
40.50	30.67	111.94	.57	-.1817
41.00	30.37	112.98	.71	-.1500
41.50	30.19	114.04	.24	.0000
42.00	30.00	114.18	1.10	-.2740
42.50	29.81	115.06	.42	.0000
43.00	29.67	115.39	.59	-.0202
43.50	29.41	115.32	1.37	-.1586
44.00	29.26	116.05	.42	.1038
44.50	29.05	115.95	1.11	-.1702
45.00	28.70	116.36	1.16	.0173

C-CYCLE CYCLE N-1

ELAPSED TIME (SEC)	VELOCITY (MI/HR)	VOLTAGE (VOLTS)	CURRENT (AMPS)	POWER (KW)
45.50	28.48	116.79	.49	.1038
46.00	28.38	116.54	1.58	-.0635
46.50	28.20	117.09	.91	.0663
47.00	28.08	117.20	1.13	-.0288
47.50	27.91	119.15	-9.03	2.1026
48.00	27.47	128.80	-53.23	7.2595
48.50	26.62	129.53	-53.24	7.8479
49.00	25.58	130.23	-53.86	7.6748
49.50	24.62	130.14	-47.93	7.6344
50.00	23.66	129.84	-48.64	7.1758
50.50	22.56	129.39	-41.33	6.5904
51.00	21.23	128.54	-36.56	6.1145
51.50	19.65	127.75	-31.62	5.4223
52.00	17.57	127.47	-26.81	4.7877
52.50	14.97	125.60	-18.61	3.3053
53.00	12.45	124.64	-14.36	2.3131
53.50	10.52	123.75	-10.59	1.6382
54.00	9.22	121.46	4.25	.3894
54.50	8.39	120.65	6.99	.8739
55.00	7.92	120.93	1.28	.0000
55.50	7.49	121.02	1.25	-.0202
56.00	6.30	121.23	.56	.0952
56.50	5.57	120.69	1.46	-.1384
57.00	3.45	121.18	.47	.0490
57.50	1.34	121.10	.66	.0029
58.00	.20	120.80	1.15	-.0981

D-CYCLE CYCLE 3

ELAPSED TIME (SEC)	VELOCITY (MI/HR)	VOLTAGE (VOLTS)	CURRENT (AMPS)	POWER (KW)
.50	.25	140.32	-1.10	.3461
1.00	.20	138.80	17.16	2.3939
1.50	.77	136.71	37.65	5.4050
2.00	1.84	137.28	34.74	5.5780
2.50	2.76	135.71	52.61	6.7201
3.00	3.57	134.38	71.81	9.8612
3.50	4.70	131.85	112.43	15.3208
4.00	6.00	130.75	117.55	16.5033
4.50	7.27	131.84	104.70	14.8882
5.00	8.30	132.14	95.75	13.3941
5.50	9.05	132.32	88.85	12.1713
6.00	9.74	132.96	84.48	11.7156
6.50	10.34	132.67	81.74	11.0464
7.00	10.67	135.19	46.16	7.8507
7.50	10.77	137.83	17.36	2.6419
8.00	10.74	135.17	46.95	5.6415
8.50	11.27	128.42	155.87	19.0183
9.00	12.40	125.27	200.36	25.2251
9.50	13.58	122.62	238.06	29.2918
10.00	14.95	121.73	258.56	32.2221
10.50	16.36	118.95	296.58	34.6044
11.00	17.50	113.75	395.35	43.9088
11.50	19.55	114.74	375.90	43.7819
12.00	21.19	116.37	339.45	40.0382
12.50	22.63	118.33	310.60	37.3848
13.00	23.94	119.27	289.38	34.8236
13.50	24.39	120.22	272.55	33.0354
14.00	25.93	130.49	102.86	17.5474
14.50	26.29	136.37	14.86	2.4227
15.00	26.20	136.43	21.22	3.1034
15.50	26.34	132.10	85.13	9.4601
16.00	26.66	116.83	341.62	34.7775
16.50	27.50	112.00	427.57	48.2062
17.00	28.75	112.66	404.06	45.8181
17.50	29.92	113.88	383.68	43.9838
18.00	31.09	115.05	365.88	42.3975
18.50	32.04	115.50	351.39	40.7939
19.00	32.92	116.63	337.08	39.6287
19.50	33.86	116.99	325.91	38.3423
20.00	34.63	117.58	315.39	37.1425
20.50	35.39	118.51	304.99	36.4792
21.00	36.11	118.51	297.01	35.3197
21.50	36.67	131.19	89.02	16.2956
22.00	36.96	137.03	7.93	1.0325
22.50	36.95	126.27	178.02	16.3649

D-CYCLE CYCLE 3

ELAPSED TIME (SEC)	VELOCITY (MI/HR)	VOLTAGE (VOLTS)	CURRENT (AMPS)	POWER (KW)
23.00	37.28	111.36	438.89	47.0122
23.50	38.07	110.35	446.42	49.4695
24.00	38.92	110.93	433.73	48.2870
24.50	39.85	111.91	421.06	47.3583
25.00	40.73	112.08	410.57	46.2046
25.50	41.54	112.92	399.84	45.3624
26.00	42.36	113.42	390.37	44.4799
26.50	43.05	113.62	382.64	43.5627
27.00	43.72	114.56	374.13	43.0666
27.50	44.40	116.84	325.73	40.0555
28.00	44.83	125.18	176.87	23.4311
28.50	45.19	125.87	171.03	21.9544
29.00	45.35	125.93	166.32	21.2045
29.50	45.51	126.47	164.60	21.2161
30.00	45.72	126.28	164.45	21.0718
30.50	45.80	126.32	161.38	20.7661
31.00	45.91	128.97	125.83	17.2590
31.50	46.05	129.31	114.70	15.1420
32.00	46.04	130.37	102.26	14.0171
32.50	46.01	131.36	88.55	12.2405
33.00	45.95	131.90	76.60	10.3600
33.50	45.89	132.65	71.14	9.9331
34.00	45.82	132.36	71.12	9.6562
34.50	45.69	132.68	67.48	9.3794
35.00	45.58	134.37	50.94	7.4931
35.50	45.41	134.22	49.07	6.7144
36.00	45.17	134.52	48.43	6.7201
36.50	45.05	134.61	47.08	6.6371
37.00	44.88	134.41	48.45	6.5183
37.50	44.73	134.82	47.63	6.7086
38.00	44.56	134.59	46.90	6.5932
38.50	44.31	134.55	48.77	6.6048
39.00	44.21	134.89	47.93	6.7490
39.50	44.09	134.40	50.35	6.7086
40.00	43.94	134.04	58.37	7.9661
40.50	43.83	132.70	75.21	9.7197
41.00	43.70	130.70	102.66	13.1057
41.50	43.74	129.33	131.81	17.0744
42.00	43.82	126.35	173.35	21.4410
42.50	43.88	124.26	208.01	25.5942
43.00	44.13	122.44	237.24	28.9226
43.50	44.38	124.95	189.91	25.3635
44.00	44.59	128.00	143.70	19.3817
44.50	44.75	128.73	129.57	17.2070
45.00	44.83	129.11	121.26	15.9611

D-CYCLE				CYCLE 3	D-CYCLE				CYCLE 3
ELAPSED TIME (SEC)	VELOCITY (MI/HR)	VOLTAGE (VOLTS)	CURRENT (AMPS)	POWER (KW)	ELAPSED TIME (SEC)	VELOCITY (MI/HR)	VOLTAGE (VOLTS)	CURRENT (AMPS)	POWER (KW)
45.50	44.90	129.63	118.72	15.7996	68.00	45.11	131.40	90.47	12.3443
46.00	44.85	129.41	117.40	15.4650	68.50	45.10	131.35	91.51	12.2578
46.50	44.81	129.58	116.60	15.4708	69.00	45.04	131.45	90.72	12.3789
47.00	44.91	129.49	117.30	15.4938	69.50	45.01	131.36	91.44	12.2809
47.50	44.96	129.25	119.49	15.5977	70.00	44.97	131.39	91.36	12.3443
48.00	44.96	129.26	124.33	16.3476	70.50	45.00	131.65	90.62	12.3962
48.50	45.02	128.94	127.07	16.6590	71.00	44.97	131.34	91.69	12.3443
49.00	45.03	128.88	126.55	16.5264	71.50	44.90	131.42	91.11	12.3789
49.50	45.04	129.24	123.91	16.4687	72.00	44.90	131.34	91.89	12.3155
50.00	45.07	128.90	125.20	16.3706	72.50	44.87	131.35	90.99	12.3847
50.50	45.06	129.28	122.31	16.2380	73.00	44.97	131.44	91.64	12.4481
51.00	45.11	129.43	118.69	15.7188	73.50	44.84	131.35	90.79	12.2693
51.50	45.16	129.35	118.57	15.5631	74.00	44.77	131.29	92.09	12.4133
52.00	45.16	129.78	116.47	15.5111	74.50	44.78	131.53	90.59	12.4539
52.50	45.14	129.47	116.47	15.3092	75.00	44.73	131.36	92.14	12.4078
53.00	45.09	129.54	116.10	15.3323	75.50	44.64	131.43	91.26	12.3962
53.50	45.16	129.74	115.50	15.3208	76.00	44.76	131.25	92.24	12.4654
54.00	45.17	129.56	116.05	15.2573	76.50	44.65	131.27	91.51	12.3155
54.50	45.17	129.72	115.40	15.2804	77.00	44.38	131.50	91.06	12.4827
55.00	45.23	129.52	115.73	15.3323	77.50	44.32	131.35	91.64	12.3674
55.50	45.23	129.49	115.88	15.3150	78.00	44.22	131.28	91.49	12.3789
56.00	45.31	129.81	115.10	15.3612	78.50	44.15	131.39	91.96	12.4827
56.50	45.37	129.58	115.75	15.2285	79.00	44.08	131.32	91.59	12.4424
57.00	45.37	129.67	115.50	15.2170	79.50	43.99	135.87	27.83	5.8203
57.50	45.40	129.81	113.66	15.1420	80.00	43.82	138.03	.60	.2884
58.00	45.39	130.39	103.21	13.9364	80.50	43.52	138.16	.92	.2538
58.50	45.46	131.01	97.45	13.2730	81.00	43.27	138.50	.42	.3461
59.00	45.53	130.76	97.72	13.1057	81.50	42.93	138.46	1.02	.2480
59.50	45.47	130.70	97.72	13.0538	82.00	42.69	138.61	.55	.2538
60.00	45.45	130.93	97.15	13.1403	82.50	42.42	138.66	.60	.2307
60.50	45.40	130.93	96.55	13.0538	83.00	42.10	138.68	.92	.2307
61.00	45.35	131.06	96.13	13.0423	83.50	41.79	138.88	.45	.3230
61.50	45.36	130.93	96.20	13.0019	84.00	41.54	138.85	.57	.2250
62.00	45.35	130.91	97.37	12.9615	84.50	41.32	138.90	.57	.2711
62.50	45.35	131.19	96.33	13.1576	85.00	41.06	139.01	.30	.2711
63.00	45.35	130.92	96.35	13.0250	85.50	40.75	138.99	.67	.3173
63.50	45.30	130.90	96.33	12.9558	86.00	40.44	139.06	.60	.2538
64.00	45.29	131.10	96.33	13.0192	86.50	40.18	139.06	.42	.3288
64.50	45.26	131.02	95.80	12.8577	87.00	39.96	139.16	.50	.2538
65.00	45.22	131.27	94.13	12.8577	87.50	39.70	139.27	.12	.3346
65.50	45.27	131.25	91.69	12.3674	88.00	39.39	139.19	.60	.2711
66.00	45.24	131.31	90.39	12.2635	88.50	39.10	139.20	.62	.2077
66.50	45.20	131.55	91.02	12.4020	89.00	38.88	139.28	.30	.2192
67.00	45.14	131.32	90.52	12.2520	89.50	38.66	138.96	5.96	.7210
67.50	45.05	131.34	91.41	12.2866	90.00	38.20	141.25	-24.11	4.5974

D-CYCLE CYCLE 3

ELAPSED TIME (SEC)	VELOCITY (MI/HR)	VOLTAGE (VOLTS)	CURRENT (AMPS)	POWER (KW)
90.50	37.23	142.10	-32.49	6.0568
91.00	35.74	142.44	-35.78	6.4317
91.50	34.02	142.60	-37.88	6.4548
92.00	32.20	142.44	-34.11	6.3683
92.50	30.29	142.13	-30.60	5.8087
93.00	28.35	142.01	-27.88	5.5665
93.50	26.53	141.89	-25.48	5.2319
94.00	24.99	142.02	-25.73	4.9954
94.50	23.55	141.85	-21.39	4.7474
95.00	22.11	141.61	-21.49	4.9146
95.50	20.78	141.60	-17.93	4.1590
96.00	19.39	141.60	-18.33	3.3226
96.50	17.71	141.14	-11.64	2.6131
97.00	15.75	141.11	-10.60	2.1574
97.50	13.65	140.91	-8.08	1.8574
98.00	11.46	140.79	-6.26	1.4190
98.50	9.21	140.63	-3.44	.9806
99.00	6.75	140.23	-.10	.3980
99.50	4.08	140.16	.62	.3980
100.00	1.68	140.25	.35	.2596

D-CYCLE				CYCLE N-1	D-CYCLE				CYCLE N-1
ELAPSED TIME (SEC)	VELOCITY (MI/HR)	VOLTAGE (VOLTS)	CURRENT (AMPS)	POWER (KW)	ELAPSED TIME (SEC)	VELOCITY (MI/HR)	VOLTAGE (VOLTS)	CURRENT (AMPS)	POWER (KW)
.50	.04	129.27	1.80	.1096	23.00	35.07	86.78	276.54	22.9696
1.00	.06	126.69	28.45	2.8034	23.50	35.45	87.24	270.35	22.7966
1.50	.86	120.37	95.13	9.3274	24.00	35.93	87.32	265.64	22.3928
2.00	2.76	105.14	246.02	22.0006	24.50	36.30	87.01	262.07	21.8390
2.50	5.41	98.65	308.70	28.3573	25.00	36.65	87.59	257.34	21.8333
3.00	8.13	97.82	306.61	29.1072	25.50	37.01	87.26	254.04	21.2910
3.50	10.25	101.80	250.03	25.1155	26.00	37.29	87.44	250.33	21.0603
4.00	11.99	105.13	216.34	22.4909	26.50	37.68	87.78	246.49	20.9622
4.50	13.34	106.44	195.69	20.3393	27.00	37.98	87.37	244.10	20.4085
5.00	14.37	107.85	180.23	19.0875	27.50	38.25	87.90	240.38	20.4142
5.50	15.27	119.62	59.82	9.5293	28.00	38.60	87.86	237.76	20.0855
6.00	15.63	125.40	11.74	1.4363	28.50	38.87	87.75	235.24	19.7913
6.50	15.91	106.54	211.08	16.3822	29.00	39.16	88.29	231.73	19.7913
7.00	16.91	95.82	300.77	28.1208	29.50	39.46	87.80	230.33	19.4048
7.50	18.15	97.15	276.79	26.1307	30.00	39.66	88.07	227.51	19.2548
8.00	19.29	98.66	258.36	24.9020	30.50	39.98	88.33	224.94	19.1567
8.50	20.28	99.18	244.49	23.4888	31.00	40.21	87.89	223.67	18.7587
9.00	21.13	100.44	230.88	22.5428	31.50	40.43	88.46	220.90	18.8914
9.50	22.00	101.16	220.48	21.7756	32.00	40.72	88.11	219.63	18.5557
10.00	22.72	101.31	213.00	20.8123	32.50	40.87	88.11	217.76	18.3665
10.50	23.37	102.46	204.80	20.4950	33.00	41.16	88.60	215.09	18.4645
11.00	24.03	102.50	193.31	19.7624	33.50	41.40	88.05	214.45	18.1415
11.50	24.60	103.00	194.30	19.3586	34.00	41.51	88.44	212.50	18.1011
12.00	25.20	103.65	189.74	19.1046	34.50	41.72	88.44	210.38	17.9396
12.50	25.71	107.28	145.87	16.5321	35.00	41.85	88.13	210.13	17.7723
13.00	25.90	121.45	24.61	4.0436	35.50	42.04	86.68	207.94	17.8243
13.50	25.94	107.54	164.25	13.2211	36.00	42.25	88.21	207.36	17.5935
14.00	26.34	93.45	286.39	25.5654	36.50	42.33	88.24	206.19	17.4551
14.50	27.13	94.37	273.24	25.0209	37.00	42.50	88.51	204.40	17.4955
15.00	27.81	94.26	264.17	24.0137	37.50	42.67	88.03	204.05	17.1436
15.50	28.36	94.61	256.24	23.5061	38.00	42.80	88.44	202.25	17.2705
16.00	28.98	95.29	247.96	22.9869	38.50	43.00	88.20	201.53	17.1551
16.50	29.54	95.06	242.52	22.1736	39.00	43.16	87.98	200.98	16.8955
17.00	30.05	95.76	236.04	21.9890	39.50	43.28	88.48	198.84	16.9994
17.50	30.59	95.81	231.33	21.4179	40.00	43.45	87.97	198.61	16.7225
18.00	31.09	95.76	226.99	20.8700	40.50	43.57	88.26	197.12	16.6937
18.50	31.46	96.52	221.53	20.8526	41.00	43.69	88.34	195.99	16.6937
19.00	31.94	96.06	218.76	20.2643	41.50	43.77	87.84	196.09	16.4110
19.50	32.33	96.59	214.52	20.0393	42.00	43.84	88.28	194.50	16.5841
20.00	32.79	96.78	210.83	19.9066	42.50	43.97	87.93	194.27	16.4052
20.50	33.14	96.51	208.49	19.2375	43.00	43.93	87.75	193.90	16.2899
21.00	33.50	98.22	195.50	18.9895	43.50	44.01	88.07	192.58	16.3822
21.50	33.79	94.00	232.82	19.5951	44.00	44.09	87.52	192.73	16.0649
22.00	34.11	86.80	289.25	24.1406	44.50	44.07	87.84	191.48	16.1110
22.50	34.64	87.16	281.57	23.6791	45.00	44.18	87.81	190.76	16.0764

D-CYCLE				CYCLE N-1	D-CYCLE				CYCLE N-1
ELAPSED TIME (SEC)	VELOCITY (MI/HR)	VOLTAGE (VOLTS)	CURRENT (AMPS)	POWER (KW)	ELAPSED TIME (SEC)	VELOCITY (MI/HR)	VOLTAGE (VOLTS)	CURRENT (AMPS)	POWER (KW)
45.50	44.21	87.31	190.98	15.9149	68.00	45.18	87.01	156.15	12.9269
46.00	44.27	87.74	189.56	15.9668	68.50	45.08	87.48	154.70	13.0538
46.50	44.34	87.26	189.84	15.8399	69.00	44.97	87.22	154.48	12.8404
47.00	44.27	87.25	189.21	15.7246	69.50	44.92	87.21	154.40	12.8519
47.50	44.34	87.55	188.14	15.9092	70.00	44.99	87.21	154.08	12.7942
48.00	44.38	87.08	188.29	15.7361	70.50	44.98	87.03	153.30	12.6789
48.50	44.43	87.20	187.44	15.7130	71.00	44.95	87.33	152.36	12.8000
49.00	44.54	87.08	186.87	15.6380	71.50	44.96	87.00	152.98	12.6385
49.50	44.52	86.91	186.77	15.4650	72.00	44.94	87.20	151.41	12.5289
50.00	44.58	87.23	185.40	15.6438	72.50	44.94	87.77	148.24	12.7712
50.50	44.64	86.79	185.62	15.3554	73.00	44.93	87.69	147.29	12.6731
51.00	44.60	86.85	184.90	15.3323	73.50	44.92	88.06	145.72	12.7135
51.50	44.68	86.98	184.05	15.3208	74.00	44.93	87.92	145.35	12.6558
52.00	44.71	86.47	184.35	15.1996	74.50	44.84	87.50	145.35	12.4827
52.50	44.70	86.81	183.18	15.3150	75.00	44.79	89.53	141.43	12.5001
53.00	44.77	86.41	183.25	15.1823	75.50	44.77	92.53	113.33	11.2483
53.50	44.75	86.20	183.15	15.0035	76.00	44.66	96.00	94.46	9.9850
54.00	44.78	86.67	181.91	15.2400	76.50	44.60	96.58	93.63	10.2273
54.50	44.86	86.10	182.20	15.0208	77.00	44.46	96.40	95.10	10.0485
55.00	44.84	86.16	181.51	15.0093	77.50	44.31	96.97	93.16	10.1119
55.50	44.87	86.23	180.88	15.0208	78.00	44.24	96.81	94.33	10.3658
56.00	44.85	86.53	174.67	14.4728	78.50	44.13	96.88	94.98	10.4061
56.50	44.89	87.46	169.51	14.3575	79.00	44.05	103.55	25.31	7.7931
57.00	44.92	87.38	168.47	14.0344	79.50	43.86	116.06	.50	5.5953
57.50	44.91	87.17	168.32	13.9306	80.00	43.57	117.27	.37	5.2550
58.00	44.90	87.51	167.04	14.1325	80.50	43.33	118.09	.12	5.7396
58.50	44.90	87.17	166.97	13.7749	81.00	43.05	118.49	.57	5.6357
59.00	44.85	87.44	165.82	13.9191	81.50	42.76	119.25	-.30	5.4107
59.50	44.28	87.43	165.12	13.8960	82.00	42.47	119.40	.40	3.3503
60.00	44.85	87.28	164.33	13.6307	82.50	42.13	119.75	.27	2.8669
60.50	44.86	87.62	163.53	13.8037	83.00	41.88	120.33	-.47	4.7301
61.00	44.87	87.26	163.13	13.5614	83.50	41.62	120.32	.35	5.0242
61.50	44.81	87.44	162.08	13.5326	84.00	41.31	120.72	.07	4.6205
62.00	44.87	87.61	161.41	13.6133	84.50	41.05	120.83	.17	5.4857
62.50	44.90	87.29	161.38	13.4807	85.00	40.78	120.98	.30	3.0284
63.00	45.02	87.46	160.91	13.4230	85.50	40.56	121.50	-.45	.1846
63.50	45.12	87.35	160.36	13.2730	86.00	40.29	121.38	.30	.0258
64.00	44.99	87.25	160.29	13.3249	86.50	39.95	121.57	.22	.0692
64.50	44.95	87.59	158.49	13.4288	87.00	39.71	121.93	-.05	.1961
65.00	45.04	87.07	159.49	13.0884	87.50	39.44	122.00	.25	1.0268
65.50	44.98	87.41	157.19	13.1749	88.00	39.12	122.26	-.02	2.8265
66.00	44.92	87.18	159.81	13.2038	88.50	38.89	121.95	3.22	.7326
66.50	44.93	86.90	160.01	13.0134	89.00	38.54	125.78	-22.34	3.6860
67.00	44.95	87.22	158.64	13.1207	89.50	37.92	129.58	-40.97	7.9373
67.50	45.14	87.16	156.45	13.0423	90.00	37.04	130.86	-48.90	10.5215

D-CYCLE

CYCLE N-1

ELAPSED TIME (SEC)	VELOCITY (MI/HR)	VOLTAGE (VOLTS)	CURRENT (AMPS)	POWER (KW)
90.50	36.10	131.25	-49.05	3.8870
91.00	35.24	131.42	-48.77	10.2965
91.50	34.35	131.28	-45.78	8.2142
92.00	33.47	131.81	-48.35	7.4989
92.50	32.63	131.77	-50.00	7.3431
93.00	31.76	130.82	-38.40	6.7721
93.50	30.90	131.39	-40.65	6.6798
94.00	30.01	130.80	-37.05	6.7086
94.50	29.06	130.82	-38.10	6.7548
95.00	28.22	130.55	-33.36	6.1491
95.50	27.34	130.26	-28.53	5.4165
96.00	26.44	130.50	-28.95	5.6588
96.50	25.55	129.84	-26.03	5.4107
97.00	24.54	129.25	-21.99	3.3976
97.50	23.25	128.91	-18.58	2.6592
98.00	20.81	128.59	-18.63	2.1920
98.50	16.66	127.74	-10.62	1.5517
99.00	11.94	126.94	-4.06	.8133
99.50	7.02	126.28	.62	.2192
100.00	2.66	126.42	-.10	.2019

APPENDIX C

TABULATIONS OF DATA FROM MAXIMUM

ACCELERATION AND COAST-DOWN TESTS

0%, CYCLE 1

EVA CURRENT FARE STATION WAGON
ACCELERATION AND GRADEABILITY

ELAPSED TIME (SEC)	VELOCITY (KM/HR)	ACCEL. (KM/HR/SEC)	GRADE (%)	AVG. VEL. (KM/HR)
.50	5.14	5.27	15.20	3.82
1.00	5.95	1.63	4.65	5.54
1.50	9.15	6.39	18.52	7.55
2.00	13.80	9.31	27.52	11.47
2.50	18.28	8.96	26.40	16.04
3.00	21.79	7.03	20.45	20.04
3.50	23.90	4.21	12.09	22.85
4.00	25.72	3.65	10.45	24.81
4.50	26.21	.98	2.81	25.97
5.00	27.49	2.55	7.28	26.85
5.50	30.83	6.69	19.43	29.16
6.00	33.19	4.71	13.55	32.01
6.50	35.09	3.80	10.91	34.14
7.00	37.13	4.07	11.69	36.11
7.50	38.54	2.83	8.09	37.84
8.00	40.12	3.16	9.04	39.33
8.50	41.44	2.63	7.52	40.78
9.00	42.45	2.03	5.80	41.95
9.50	43.83	2.76	7.90	43.14
10.00	44.89	2.12	6.06	44.36
10.50	45.93	2.06	5.89	45.41
11.00	47.10	2.36	6.73	46.52
11.50	47.65	1.10	3.14	47.38
12.00	48.24	1.17	3.35	47.95
12.50	50.22	3.95	11.34	49.23
13.00	51.24	2.05	5.86	50.73
13.50	52.79	3.09	8.85	52.02
14.00	53.90	2.23	6.36	53.35
14.50	55.10	2.40	6.85	54.50
15.00	56.42	2.63	7.52	55.76
15.50	57.45	2.05	5.86	56.93
16.00	58.53	2.17	6.21	57.99
16.50	59.36	1.66	4.74	58.95
17.00	60.22	1.72	4.90	59.79
17.50	61.29	2.15	6.13	60.76
18.00	61.55	.52	1.47	61.42
18.50	63.06	3.02	8.64	62.31
19.00	64.43	2.74	7.82	63.75
19.50	65.51	2.16	6.16	64.97
20.00	66.70	2.39	6.82	66.11
20.50	67.71	2.01	5.74	67 21
21.00	68.75	2.08	5.95	68.23
21.50	69.91	2.32	6.61	69.33
22.00	70.63	1.44	4.10	70.27
22.50	71.88	2.51	7.17	71.25

0%

EVA CURRENT FARE STATION WAGON
ACCELERATION AND GRADEABILITY

ELAPSED TIME (SEC)	VELOCITY (KM/HR)	ACCEL. (KM/HR/SEC)	GRADE (%)	AVG. VEL. (KM/HR)
23.00	72.75	1.74	4.96	72.32
23.50	73.44	1.37	3.92	73.09
24.00	74.46	2.05	5.84	73.95
24.50	75.47	2.02	5.77	74.97
25.00	76.39	1.84	5.26	75.93
25.50	77.17	1.56	4.44	76.78
26.00	77.14	-.05	-.15	77.16
26.50	77.66	1.03	2.93	77.40
27.00	78.20	1.08	3.09	77.93
27.50	78.57	.74	2.12	78.39
28.00	79.20	1.27	3.62	78.89
28.50	79.70	.99	2.82	79.45
29.00	80.02	.63	1.80	79.86
29.50	80.58	1.13	3.23	80.30
30.00	80.72	.23	.66	80.64
30.50	81.39	1.39	3.98	81.05
31.00	81.86	.94	2.69	81.63
31.50	82.04	.34	.97	81.95
32.00	82.63	1.19	3.39	82.33
32.50	82.79	.32	.91	82.71
33.00	83.50	1.42	4.04	83.14
33.50	83.56	.12	.34	83.53
34.00	83.67	.22	.61	83.61
34.50	84.66	1.98	5.66	84.16
35.00	84.55	-.21	-.60	84.61
35.50	84.71	.31	.88	84.63
36.00	85.19	.96	2.75	84.95
36.50	85.25	.13	.36	85.22
37.00	85.66	.82	2.34	85.46
37.50	85.91	.48	1.38	85.79
38.00	86.07	.33	.93	85.99
38.50	86.83	1.52	4.32	86.45
39.00	86.58	-.50	-1.42	86.70
39.50	86.98	.82	2.33	86.78
40.00	87.63	1.29	3.69	87.31
40.50	87.89	.51	1.45	87.76
41.00	88.04	.31	.87	87.96
41.50	87.92	-.23	-.66	87.98
42.00	88.29	.73	2.07	88.11
42.50	88.44	.31	.88	88.36
43.00	88.32	-.25	-.72	88.38
43.50	88.59	.54	1.54	88.45
44.00	89.11	1.05	3.00	88.85
44.50	88.99	-.24	-.69	89.05
45.00	89.22	.46	1.32	89.11

0%

EVA CURRENT FARE STATION WAGON
ACCELERATION AND GRADEABILITY

ELAPSED TIME (SEC)	VELOCITY (KM/HR)	ACCEL. (KM/HR/SEC)	GRADE (%)	AVG. VEL. (KM/HR)
45.50	89.44	.44	1.26	89.33
46.00	89.49	.09	.25	89.47
46.50	89.86	.73	2.09	89.67
47.00	89.67	-.36	-1.03	89.76
47.50	90.04	.74	2.10	89.86
48.00	91.03	1.98	5.65	90.54
48.50	91.11	.15	.43	91.07
49.00	91.30	.39	1.11	91.21
49.50	90.86	-.89	-2.55	91.08
50.00	90.74	-.22	-.63	90.80
50.50	90.96	.44	1.24	90.85
51.00	91.36	.80	2.28	91.16
51.50	91.68	.63	1.80	91.52
52.00	91.79	.22	.63	91.73
52.50	91.67	-.23	-.66	91.73
53.00	91.62	-.10	-.28	91.65
53.50	91.80	.35	.99	91.71
54.00	92.30	1.00	2.85	92.05
54.50	92.06	-.48	-1.36	92.18
55.00	91.97	-.18	-.51	92.01
55.50	92.60	1.26	3.59	92.28
56.00	92.36	-.47	-1.33	92.48
56.50	92.42	.11	.31	92.39
57.00	93.04	1.24	3.53	92.73
57.50	93.64	1.20	3.42	93.34
58.00	93.55	-.17	-.49	93.59
58.50	93.77	.44	1.24	93.66
59.00	93.42	-.69	-1.97	93.60
59.50	93.96	1.08	3.08	93.69
60.00	93.60	-.72	-2.04	93.78
60.50	94.16	1.12	3.18	93.88
61.00	94.24	.15	.42	94.20
61.50	94.12	-.23	-.66	94.18
62.00	94.42	.60	1.71	94.27
62.50	94.44	.05	.13	94.43
63.00	94.18	-.54	-1.53	94.31
63.50	94.49	.63	1.80	94.33
64.00	94.86	.74	2.12	94.68
64.50	94.27	-1.18	-3.36	94.57
65.00	94.83	1.12	3.20	94.55
65.50	94.20	-1.26	-3.59	94.52
66.00	94.49	.57	1.62	94.35
66.50	94.62	.25	.72	94.55
67.00	94.82	.42	1.18	94.72
67.50	95.46	1.28	3.65	95.14

0%

EVA CURRENT FARE STATION WAGON
ACCELERATION AND GRADEABILITY

ELAPSED TIME (SEC)	VELOCITY (KM/HR)	ACCEL. (KM/HR/SEC)	GRADE (%)	AVG. VEL. (KM/HR)
68.00	94.74	-1.44	-4.10	95.10
68.50	95.08	.67	1.92	94.91
69.00	94.92	-.32	-.91	95.00
69.50	94.50	-.83	-2.37	94.71
70.00	95.39	1.77	5.06	94.95
70.50	95.18	-.42	-1.18	95.29
71.00	94.63	-1.11	-3.17	94.91
71.50	94.45	-.35	-1.00	94.54

40%, CYCLE 13

EVA CURRENT FARE STATION WAGON
ACCELERATION AND GRADEABILITY

ELAPSED TIME (SEC)	VELOCITY (KM/HR)	ACCEL. (KM/HR/SEC)	GRADE (%)	AVG. VEL. (KM/HR)
.50	3.06	1.11	3.18	2.78
1.00	7.42	8.72	25.67	5.24
1.50	11.98	9.12	26.92	9.70
2.00	17.06	10.17	30.27	14.52
2.50	20.74	7.35	21.43	18.90
3.00	23.20	4.93	14.19	21.97
3.50	25.38	4.35	12.50	24.29
4.00	26.88	2.99	8.56	26.13
5.00	28.23	2.46	7.04	27.62
5.50	31.08	5.70	16.46	29.66
6.00	33.67	5.18	14.92	32.38
6.50	35.66	3.98	11.43	34.67
7.00	37.49	3.66	10.48	36.58
7.50	39.26	3.54	10.15	38.38
8.00	40.73	2.94	8.41	40.00
8.50	42.17	2.88	8.23	41.45
9.00	43.43	2.52	7.20	42.80
9.50	44.45	2.04	5.83	43.94
10.00	45.90	2.90	8.29	45.18
10.50	46.71	1.62	4.61	46.31
11.00	47.64	1.87	5.33	47.18
11.50	48.48	1.67	4.77	48.06
12.00	48.82	.68	1.95	48.65
12.50	49.14	.63	1.78	48.98
13.00	51.13	3.98	11.41	50.13
13.50	52.19	2.13	6.07	51.66
14.00	53.83	3.29	9.41	53.01
14.50	54.76	1.86	5.32	54.30
15.00	55.87	2.22	6.34	55.32
15.50	57.12	2.49	7.11	56.50
16.00	58.20	2.15	6.15	57.66
16.50	59.05	1.71	4.88	58.62
17.00	59.89	1.69	4.82	59.47
17.50	60.38	.96	2.75	60.14
18.00	61.27	1.79	5.12	60.82
18.50	61.52	.49	1.41	61.40
19.00	61.85	.65	1.86	61.68
19.50	62.54	1.38	3.93	62.19
20.00	62.80	.53	1.51	62.67
20.50	63.62	1.63	4.65	63.21
21.00	64.23	1.23	3.50	63.92
21.50	64.69	.93	2.64	64.46
22.00	65.19	1.00	2.85	64.94
22.50	65.59	.79	2.25	65.39
23.00	66.04	.90	2.57	65.81

40%

EVA CURRENT FARE STATION WAGON
ACCELERATION AND GRADEABILITY

ELAPSED TIME (SEC)	VELOCITY (KM/HR)	ACCEL. (KM/HR/SEC)	GRADE (%)	AVG. VEL. (KM/HR)
23.50	66.81	1.55	4.43	66.43
24.00	67.60	1.58	4.50	67.21
24.50	68.61	2.00	5.72	68.11
25.00	69.54	1.86	5.32	69.07
25.50	70.31	1.55	4.43	69.93
26.00	71.30	1.96	5.60	70.80
26.50	72.22	1.86	5.30	71.76
27.00	73.24	2.24	6.39	72.78
27.50	74.07	1.45	4.14	73.71
28.00	74.69	1.25	3.57	74.38
28.50	75.72	2.05	5.84	75.21
29.00	76.42	1.40	3.99	76.07
29.50	77.23	1.63	4.65	76.83
30.00	78.14	1.80	5.15	77.69
30.50	78.59	.91	2.60	78.36
31.00	79.62	2.06	5.87	79.11
31.50	80.19	1.15	3.27	79.91
32.00	80.63	.87	2.48	80.41
32.50	81.44	1.63	4.65	81.04
33.00	81.91	.94	2.67	81.68
33.50	82.54	1.26	3.60	82.23
34.00	83.32	1.55	4.41	82.93
34.50	83.79	.95	2.72	83.56
35.00	84.59	1.59	4.53	84.19
35.50	84.81	.44	1.26	84.70
36.00	85.42	1.22	3.47	85.11
36.50	86.39	1.95	5.57	85.90
37.00	86.56	.33	.93	86.47
37.50	87.21	1.31	3.72	86.88
38.00	87.27	.12	.34	87.24
38.50	87.47	.40	1.14	87.37
39.00	87.94	.94	2.69	87.70
39.50	88.34	.81	2.30	88.14
40.00	88.46	.23	.64	88.40
40.50	88.83	.74	2.12	88.64
41.00	88.99	.33	.94	88.91
41.50	89.22	.45	1.27	89.10
42.00	89.46	.49	1.39	89.34
42.50	89.48	.04	.12	89.47
43.00	90.29	1.62	4.62	89.89
43.50	90.21	.16	.45	90.25
44.00	90.25	.07	.21	90.23
44.50	90.65	.79	2.27	90.45
45.00	90.68	.07	.21	90.67
45.50	91.13	.88	2.52	90.91

40%

EVA CURRENT FARE STATION WAGON
ACCELERATION AND GRADEABILITY

ELAPSED TIME (SEC)	VELOCITY (KM/HR)	ACCEL. (KM/HR/SEC)	GRADE (%)	AVG. VEL. (KM/HR)
46.00	91.21	.17	.48	91.17
46.50	91.72	1.03	2.93	91.47
47.00	91.92	.39	1.12	91.82
47.50	91.64	-.57	-1.62	91.78
48.00	92.13	.99	2.82	91.88
48.50	92.25	.24	.67	92.19
49.00	92.22	-.06	-.16	92.24
49.50	92.68	.92	2.63	92.45
50.00	92.89	.42	1.20	92.79
50.50	92.93	.07	.21	92.91
51.00	93.02	.18	.51	92.97
51.50	92.99	-.05	-.13	93.01
52.00	93.75	1.51	4.31	93.37
52.50	93.75	0.00	0.00	93.75
53.00	93.31	-.87	-2.49	93.53
53.50	94.18	1.74	4.97	93.75
54.00	94.24	.11	.30	94.21
54.50	94.02	-.44	-1.24	94.13
55.00	94.23	.43	1.21	94.12
55.50	93.98	-.51	-1.44	94.10
56.00	94.49	1.03	2.94	94.24
56.50	94.69	.38	1.09	94.59
57.00	94.73	.09	.25	94.71
57.50	94.81	.16	.45	94.77
58.00	94.68	-.25	-.72	94.75
58.50	94.76	.15	.43	94.72
59.00	95.02	.51	1.45	94.89
59.50	94.73	-.57	-1.63	94.87
60.00	95.11	.77	2.19	94.92
60.50	95.26	.30	.85	95.19

80%, CYCLE 22

EVA CURRENT FARE STATION WAGON
ACCELERATION AND GRADEABILITY

ELAPSED TIME (SEC)	VELOCITY (KM/HR)	ACCEL. (KM/HR/SEC)	GRADE (%)	AVG. VEL. (KM/HR)
0.00	7.38	8.12	23.79	5.35
.50	11.72	8.68	25.52	9.55
1.00	16.88	10.32	30.77	14.30
1.50	20.59	7.41	21.62	18.73
2.00	22.92	4.66	13.41	21.75
2.50	25.04	4.24	12.18	23.98
3.00	26.32	3.57	10.24	25.93
3.50	22.14	2.63	7.50	27.48
4.00	29.42	2.56	7.31	28.78
4.50	29.43	.02	.06	29.42
5.00	31.96	5.07	14.61	30.69
5.50	34.49	5.06	14.56	33.23
6.00	36.24	3.49	10.01	35.36
6.50	38.14	3.79	10.88	37.19
7.00	39.64	3.01	8.61	38.29
7.50	40.93	2.59	7.40	40.29
8.00	42.45	3.09	8.85	41.71
8.50	43.46	1.95	5.57	42.97
9.00	44.58	2.25	6.42	44.02
9.50	45.57	1.97	5.63	45.08
10.00	45.74	.34	.97	45.65
10.50	47.97	4.47	12.84	46.86
11.00	49.28	2.62	7.47	48.63
11.50	50.63	2.69	7.70	49.95
12.00	52.09	2.92	8.35	51.36
12.50	53.22	2.26	6.45	52.65
13.00	54.54	2.65	7.58	53.88
13.50	55.59	2.09	5.96	55.07
14.00	56.45	1.72	4.91	56.02
14.50	57.60	2.29	6.55	57.02
15.00	58.33	1.46	4.17	57.96
15.50	59.22	1.78	5.08	58.77
16.00	60.21	1.98	5.65	59.71
16.50	60.84	1.27	3.63	60.52
17.00	61.74	1.79	5.12	61.29
17.50	62.53	1.58	4.50	62.13
18.00	63.10	1.15	3.29	62.82
18.50	64.00	1.80	5.14	63.55
19.00	64.47	.93	2.66	64.24
19.50	65.19	1.43	4.08	64.83
20.00	66.09	1.81	5.17	65.64
20.50	66.38	.58	1.65	66.24
21.00	67.17	1.58	4.52	66.78
21.50	67.55	.75	2.15	67.36
22.00	68.08	1.07	3.05	67.82

80%

EVA CURRENT FARE STATION WAGON
ACCELERATION AND GRADEABILITY

ELAPSED TIME (SEC)	VELOCITY (KM/HR)	ACCEL. (KM/HR/SEC)	GRADE (%)	AVG. VEL. (KM/HR)
22.50	68.81	1.46	4.16	68.45
23.00	69.30	.98	2.79	69.06
23.50	70.30	2.00	5.71	69.80
24.00	71.12	1.64	4.68	70.71
24.50	71.89	1.54	4.38	71.51
25.00	72.97	2.15	6.15	72.43
25.50	73.46	.98	2.81	73.21
26.00	74.15	1.38	3.95	73.80
26.50	74.77	1.24	3.54	74.46
27.00	75.85	2.16	6.16	75.31
27.50	76.76	1.82	5.18	76.30
28.00	76.52	-.47	-1.33	76.64
28.50	76.76	.48	1.36	76.64
29.00	77.62	1.70	4.86	77.19
29.50	77.88	.53	1.51	77.75
30.00	78.37	.98	2.79	78.13
30.50	78.95	1.16	3.30	78.66
31.00	79.24	.58	1.65	79.09
31.50	79.89	1.30	3.71	79.56
32.00	80.53	1.29	3.68	80.21
32.50	80.69	.31	.87	80.61
33.00	81.23	1.08	3.08	80.96
33.50	81.43	.40	1.14	81.33
34.00	81.85	.85	2.42	81.64
34.50	82.68	1.66	4.74	82.26
35.00	82.67	-.02	-.06	82.68
35.50	83.14	.95	2.70	82.91
36.00	83.39	.50	1.42	83.27
36.50	83.72	.65	1.84	83.56
37.00	84.27	1.11	3.17	83.99
37.50	84.39	.24	.67	84.33
38.00	84.79	.81	2.30	84.59
38.50	85.43	1.27	3.63	85.11
39.00	85.58	.31	.87	85.51
39.50	86.19	1.22	3.47	85.89
40.00	86.00	-.38	-1.09	86.09
40.50	86.46	.93	2.64	86.23
41.00	86.99	1.06	3.03	86.73
41.50	87.03	.07	.19	87.01
42.00	87.11	.17	.49	87.07
42.50	87.25	.28	.79	87.18
43.00	87.37	.23	.64	87.31
43.50	87.86	.99	2.84	87.62
44.00	87.87	.02	.04	87.87
44.50	88.16	.58	1.66	88.02

80%

EVA CURRENT FARE STATION WAGON
ACCELERATION AND GRADEABILITY

ELAPSED TIME (SEC)	VELOCITY (KM/HR)	ACCEL. (KM/HR/SEC)	GRADE (%)	AVG. VEL. (KM/HR)
45.00	88.48	.64	1.81	88.32
45.50	88.67	.37	1.05	88.57
46.00	88.89	.45	1.29	88.78
46.50	89.19	.60	1.71	89.04
47.00	89.49	.60	1.71	89.34
47.50	89.38	.22	.63	89.44
48.00	89.61	.46	1.32	89.50
48.50	89.66	.08	.24	89.63
49.00	89.82	.33	.93	89.74
49.50	90.05	.47	1.33	89.94
50.00	90.27	.43	1.21	90.16
50.50	90.37	.20	.57	90.32
51.00	90.57	.41	1.17	90.47
51.50	91.13	1.12	3.20	90.85
52.00	91.06	.15	.42	91.09
52.50	90.95	.22	.61	91.00
53.00	90.95	.01	.01	90.95
53.50	91.33	.75	2.13	91.14
54.00	91.59	.54	1.53	91.46
54.50	91.67	.15	.43	91.63
55.00	92.00	.66	1.89	91.84
55.50	92.33	.65	1.84	92.16
56.00	92.64	.63	1.80	92.48
56.50	93.29	1.27	3.62	92.96
57.00	93.02	.51	1.45	93.15
57.50	93.33	.63	1.78	93.18
58.00	93.55	.43	1.21	93.44
58.50	93.70	.31	.88	93.62
59.00	94.10	.81	2.30	93.90
59.50	94.19	.18	.51	94.15
60.00	93.97	.44	1.26	94.08
60.50	94.27	.60	1.71	94.12
61.00	94.42	.28	.81	94.34
61.50	94.66	.49	1.41	94.54
62.00	95.41	1.50	4.28	95.04
62.50	95.59	.36	1.02	95.50
63.00	95.81	.44	1.26	95.70
63.50	95.66	.31	.87	95.74
64.00	95.82	.33	.93	95.74

0%, CYCLE 1

EVA CURRENT FARE STATION WAGON
COASTDOWN, ROAD ENERGY AND ROAD POWER

ELAPSED TIME (SEC)	VELOCITY (KM/HR)	ROAD ENERGY (KWH/KM)	ROAD POWER (KW)	AVG. VEL. (KM/HR)
0.00	92.76	.2253	20.9713	93.03
2.50	90.18	.1777	16.2537	91.47
5.00	87.63	.1764	15.6850	88.91
7.50	84.74	.1995	17.1935	86.19
10.00	81.85	.1995	16.6171	83.30
12.50	79.63	.1535	12.3958	80.74
15.00	77.07	.1764	13.8227	78.35
17.50	74.33	.1548	11.7574	75.95
20.00	72.61	.1535	11.3180	73.72
22.50	70.47	.1479	10.5800	71.54
25.00	68.31	.1486	10.3129	69.39
27.50	66.47	.1275	8.5954	67.39
30.00	64.13	.1613	10.5354	65.30
32.50	61.75	.1642	10.3380	62.94
35.00	59.74	.1668	10.0983	60.54
37.50	57.27	.1424	8.3053	58.31
40.00	55.03	.1513	8.5024	56.18
42.50	52.59	.1719	9.2536	53.84
45.00	50.17	.1259	6.5073	51.68
47.50	48.37	.1655	8.2050	49.57
50.00	46.34	.1406	6.6594	47.35
52.50	44.13	.1526	6.9032	45.23
55.00	42.31	.1254	5.4161	43.22
57.50	40.21	.1450	5.9824	41.26
60.00	38.25	.1354	5.3103	39.23
62.50	36.59	.1150	4.3035	37.42
65.00	35.03	.1072	3.8387	35.81
67.50	33.53	.1039	3.5627	34.28
70.00	31.99	.1061	3.4761	32.76
72.50	30.62	.0945	2.9579	31.31
75.00	28.98	.1136	3.3841	29.80
77.50	27.51	.1014	2.8636	28.25
80.00	26.21	.0901	2.4204	26.86
82.50	24.75	.1005	2.5599	25.48
85.00	23.49	.0870	2.0992	24.12
87.50	22.18	.0905	2.0662	22.84
90.00	20.89	.0888	1.9135	21.54
92.50	19.64	.0865	1.7528	20.27
95.00	18.22	.0983	1.8607	18.93
97.50	16.93	.0888	1.5614	17.57
100.00	15.55	.0952	1.5463	16.24
102.50	14.16	.0965	1.4331	14.85
105.00	12.92	.0856	1.1583	13.54
107.50	11.64	.0883	1.0841	12.28
110.00	10.27	.0941	1.0311	10.96

0%

EVA CURRENT FARE STATION WAGON
COASTDOWN, ROAD ENERGY AND ROAD POWER

ELAPSED TIME (SEC)	VELOCITY (KM/HR)	ROAD ENERGY (KWH/KM)	ROAD POWER (KW)	AVG. VEL. (KM/HR)
112.50	9.08	.0825	.7982	9.68
115.00	8.12	.0663	.5703	8.60
117.50	6.80	.0910	.6791	7.46
120.00	5.77	.0714	.4487	6.28
122.50	4.86	.0629	.3340	5.31
125.00	3.67	.0823	.3507	4.26

AD-A132 549 BASELINE AND VERIFICATION TESTS OF THE ELECTRIC VEHICLE ASSOCIATES' CURRE..(U) ARMY MOBILITY EQUIPMENT RESEARCH AND DEVELOPMENT COMMAND FORT.. E J DOWGIALLO ET AL. 2/2

UNCLASSIFIED JAN 83 MERADCOM-2375 F/G 13/6 NL

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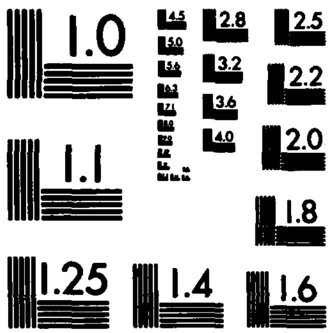

MICROCOPY RESOLUTION TEST CHART

NATIONAL BUREAU OF STANDARDS-1963-A

40%, CYCLE 13

EVA CURRENT FARE STATION WAGON
COASTDOWN, ROAD ENERGY AND ROAD POWER

ELAPSED TIME (SEC)	VELOCITY (KM/HR)	ROAD ENERGY (KWH/KM)	ROAD POWER (KW)	AVG. VEL. (KM/HR)
0.00	91.89	.1577	14.6720	93.03
2.50	89.43	.2391	21.5577	90.16
5.00	85.30	.2162	18.7808	86.86
7.50	82.74	.1770	14.8681	84.02
10.00	80.21	.1742	14.1960	81.47
12.50	77.66	.1764	13.9257	78.94
15.00	75.14	.1741	13.2976	76.40
17.50	72.80	.1617	11.9606	73.97
20.00	70.49	.1595	11.4283	71.64
22.50	67.95	.1748	12.0985	69.22
25.00	65.60	.1622	10.8348	66.78
27.50	64.23	.0952	6.1802	64.92
30.00	62.16	.1430	9.0355	63.19
32.50	60.21	.0932	5.7303	61.48
35.00	59.26	.1070	6.4241	60.03
37.50	57.58	.1154	6.7401	58.42
40.00	55.26	.1188	6.7403	56.72
42.50	54.32	.1067	5.8756	55.09
45.00	53.11	.0838	4.4989	53.71
47.50	51.75	.0934	4.8964	52.43
50.00	49.91	.1275	6.4932	50.83
52.50	48.45	.1005	4.9413	49.18
55.00	47.10	.0932	4.4531	47.78
57.50	45.65	.1001	4.6429	46.38
60.00	44.37	.0887	3.9908	45.01
62.50	43.04	.0918	4.0100	43.70
65.00	41.80	.0858	3.6377	42.42
67.50	40.62	.0814	3.3542	41.21
70.00	39.25	.0945	3.7730	39.94
72.50	37.67	.1092	4.1997	38.46
75.00	36.00	.1152	4.2431	36.84
77.50	34.36	.1136	3.9948	35.18
80.00	32.61	.1208	4.0454	33.48
82.50	30.90	.1181	3.7499	31.75
85.00	29.34	.1076	3.2395	30.12
87.50	27.77	.1083	3.0922	28.56
90.00	26.24	.1059	2.8604	27.00
92.50	24.74	.1032	2.6306	25.49
95.00	23.32	.0985	2.3664	24.03
97.50	21.71	.1106	2.4913	22.52
100.00	20.27	.0996	2.0903	20.99
102.50	18.75	.1054	2.0559	19.51
105.00	17.25	.1034	1.8607	18.00
107.50	15.88	.0943	1.5622	16.57
110.00	14.39	.1032	1.5621	15.14

0%

EVA CURRENT FARE STATION WAGON
COASTDOWN, ROAD ENERGY AND ROAD POWER

ELAPSED TIME (SEC)	VELOCITY (KM/HR)	ROAD ENERGY (KWH/KM)	ROAD POWER (KW)	AVG. VEL. (KM/HR)
112.50	9.08	.0825	.7982	9.68
115.00	8.12	.0663	.5703	8.60
117.50	6.80	.0910	.6791	7.46
120.00	5.77	.0714	.4487	6.28
122.50	4.86	.0629	.3340	5.31
125.00	3.67	.0823	.3507	4.26

40%

EVA CURRENT FARE STATION WAGON
COASTDOWN, ROAD ENERGY AND ROAD POWER

ELAPSED TIME (SEC)	VELOCITY (KM/HR)	ROAD ENERGY (KWH/KM)	ROAD POWER (KW)	AVG. VEL. (KM/HR)
112.50	12.93	.1008	1.3774	13.66
115.00	11.46	.1014	1.2364	12.20
117.50	10.11	.0934	1.0072	10.79
120.00	8.79	.0912	.8618	9.45
122.50	7.48	.0907	.7372	8.13
125.00	6.14	.0923	.6282	6.81
127.50	4.70	.0992	.5377	5.42

80%, CYCLE 22

EVA CURRENT FARE STATION WAGON
COASTDOWN, ROAD ENERGY AND ROAD POWER

ELAPSED TIME (SEC)	VELOCITY (KM/HR)	ROAD ENERGY (KWH/KM)	ROAD POWER (KW)	AVG. VEL. (KM/HR)
0.00	92.67	.1426	13.3645	93.70
2.50	90.22	.1692	15.4683	91.45
5.00	87.71	.1731	15.4047	88.97
7.50	86.45	.0874	7.6102	87.08
10.00	84.15	.1590	13.5603	85.30
12.50	81.39	.1900	15.7301	82.77
15.00	79.36	.1406	11.3030	80.38
17.50	77.47	.1306	10.2432	78.41
20.00	75.55	.1325	10.1334	76.51
22.50	73.90	.1137	8.4989	74.72
25.00	72.12	.1226	8.9542	73.01
27.50	70.22	.1314	9.3494	71.17
30.00	68.60	.1121	7.7810	69.41
32.50	66.98	.1117	7.5747	67.79
35.00	65.50	.1025	6.7876	66.24
37.50	63.82	.1156	7.4717	64.66
40.00	61.61	.1530	9.5943	62.72
42.50	59.29	.1599	9.6651	60.45
45.00	57.10	.1517	8.8286	58.19
47.50	54.66	.1543	8.6349	55.98
50.00	52.59	.1568	8.4241	53.73
52.50	50.48	.1461	7.5279	51.53
55.00	48.35	.1470	7.2628	49.41
57.50	46.80	.1070	5.0909	47.57
60.00	45.79	.0696	3.2214	46.29
62.50	44.90	.0616	2.7928	45.34
65.00	44.07	.0571	2.5379	44.48
67.50	43.22	.0545	2.3807	43.68
70.00	42.50	.0543	2.3299	42.89
72.50	41.75	.0516	2.1735	42.12
75.00	40.93	.0563	2.3284	41.34
77.50	39.99	.0652	2.6391	40.46
80.00	38.44	.1068	4.1894	39.21
82.50	37.49	.0656	2.4902	37.97
85.00	36.60	.0616	2.2817	37.04
87.50	35.58	.0705	2.5441	36.09
90.00	34.57	.0694	2.4344	35.08
92.50	33.86	.0491	1.6786	34.22
95.00	33.18	.0469	1.5714	33.52
97.50	32.38	.0554	1.8166	32.78
100.00	31.41	.0674	2.1498	31.89
102.50	30.54	.0598	1.8514	30.97
105.00	29.47	.0736	2.2080	30.01
107.50	27.64	.1265	3.6113	28.56
110.00	25.99	.1145	3.0692	26.81

80%

EVA CURRENT FARE STATION WAGON
COASTDOWN, ROAD ENERGY AND ROAD POWER

ELAPSED TIME (SEC)	VELOCITY (KM/HR)	ROAD ENERGY (KWH/KM)	ROAD POWER (KW)	AVG. VEL. (KM/HR)
112.50	24.54	.0997	2.5199	25.26
115.00	22.98	.1081	2.5683	23.76
117.50	21.10	.1292	2.8471	22.04
120.00	19.32	.1230	2.4863	20.21
122.50	17.62	.1176	2.1714	18.47
125.00	16.02	.1103	1.8552	16.82
127.50	14.60	.0985	1.5077	15.31
130.00	12.98	.1119	1.5431	13.79
132.50	11.38	.1105	1.3451	12.18
135.00	10.21	.0805	.8688	10.79
137.50	8.88	.0919	.8776	9.55
140.00	7.18	.1176	.9438	8.03
142.50	5.58	.1106	.7056	6.38
145.00	3.89	.1161	.5497	4.73

APPENDIX D

ELECTRIC AND HYBRID VEHICLE VERIFICATION PROCEDURES

BACKGROUND

The Department of Energy is required by Public Law 94-413 to issue performance standards for vehicles used in the Electric and Hybrid Vehicle (EHV) Market Demonstration. On 30 May 1978, DOE published a final rule in the Federal Register (Vol. 43, No. 104) promulgating the first Performance Standards. This rule was effective on 3 July 1978, and prescribed minimum performance standards for electric and hybrid vehicles to be purchased or leased for the first phase of a demonstration program under the Electric and Hybrid Research and Development Act of 1976. Performance Standards are updated from time to time and the current rule was published in the Federal Register on 12 February 1980 (Vol. 45, No. 30).

Manufacturers who certify that their vehicles meet the latest requirements of the DOE Performance Standards may offer those vehicles for the DOE Market Demonstration Program. DOE reserves the right to verify, by independent test, the manufacturer's self-certification. The test procedures used for DOE performance tests are based on SAE Test Procedures J227a. Safety inspection and testing services are provided by the Department of Transportation/National Highway and Traffic Safety Administration (DOT/NHTSA) through an interagency agreement. Performance testing is performed by the U.S. Army Mobility Equipment Research and Development Command (MERADCOM) through an interagency agreement. During verification testing, vehicle component or subsystem failures will be brought to the attention of the manufacturer immediately. Repeated or multiple component or subsystem failures experienced during test are grounds for invalidating the self-certification of the vehicle for purpose of the DOE Market Demonstration Program.

CERTIFICATION PROCESS

A manufacturer can certify an existing vehicle as meeting the DOE Standards (which include applicable NHTSA safety standards by reference) at any time by submitting a letter of certification and providing the required data on the vehicle to the Department of Energy Director of Electric and Hybrid Vehicles Division or his designee.

VERIFICATION PROCESS

Should DOE elect to verify the certification, arrangements will be made with the manufacturer for delivery of the vehicle to a DOE-specified site for testing. (Details of scheduling priorities are described in the following section.) Several basic types of tests may be involved:

- DOE-Sponsored Performance Tests by the U.S. Army MERADCOM.

- DOE-Sponsored Safety Inspection by DOT/NHTSA.

- DOE-Sponsored Safety Compliance Testing by the Research Division of DOT/NHTSA.

- DOT/NHTSA Safety Compliance Test (independent of DOE.)

One important principle followed by DOE during testing is to allow the Facility Manager to work with manfacturers to overcome the normal problems that occur during inspection and testing. To ensure impartial treatment of manufacturers during the test sequence, limits have been set for the Test Facility Manager concerning how many vehicle component or subsystem failures can be allowed before certification is invalidated. DOE will objectively evaluate the impact of all failures during the testing phase so that vehicles are not unfairly penalized for minor and easily correctable failures. The Test Facility Manager, however, has an obligation to conduct the testing thoroughly and to adhere to a tight schedule.

Manufacturers may be notified from time to time by the Test Facility Manager of potential and actual problems. When these problems do not involve components or subsystem failures, where failure is defined as a vehicle being below the required standard, such notification would not necessarily invalidate the certification.

TEST FACILITY SCHEDULING GUIDELINES

Vehicles will be scheduled for testing by the Test Facility Manager on a first-come, first-served basis, with certain exceptions as noted below. Scheduling is dependent upon the ability of the manufacturer to provide a vehicle for testing. The Test Facility Manager will request the manufacturer to provide a certified vehicle for testing within 60 days from the date of the request. If a vehicle is not received at the Test Facility within the 60-day period, the self-certification will be returned and the vehicle will be removed from the self-certification list.

The primary function of certification testing is to ensure that vehicles available to the Market Demonstration Program fully satisfy the applicable DOE Performance Standards. For this reason, it is necessary to establish a set of priority testing categories for vehicles selected or being considered for selection by demonstration site operators. The categories are listed below in decreasing order of priority for testing:

a. Certified vehicles which have not been verified but have been purchased by and delivered to site operators.

b. Certified vehicles purchased by, but not delivered to site operators for demonstration.

c. Certified vehicles that have been modified subsequent to verification testing and have been delivered to site operators.* On request by DOE, the manufacturer will furnish DOE with technical information about each modification in sufficient detail to determine if reverification tests are needed.

d. Certified vehicles that are being considered for purchase by a site operator.

e. Certified vehicles that are available for test but are not under consideration by a site operator.

Vehicle test schedules are sensitive to the requirements of the Market Demonstration Program, and rescheduling by the Test Facility Manager may be required to meet changing needs. Vehicles delivered late or taken out of test because of operational failure may be rescheduled on a lower priority basis by the Test Facility Manager with approval of the DOE Test Manager. On-site rectification of a vehicle problem by the manufacturer within a 5-working-day period described below may avoid the necessity for rescheduling.

VEHICLE MODIFICATION/REPAIR GUIDELINES

The guidelines provided in this section are for use by the Test Facility Manager. Exceptions to these guidelines require the approval of the Director of the DOE Electric and Hybrid Vehicle Division or his designee. The intent of these guidelines is to facilitate the establishment of a clear basis for validating or invalidating a manufacturer self-certification. Subsystem failures may raise questions as to the relevance of the results of the validation testing. It is also important that the test facilities not be used for development and test engineering. Vehicles that experience repeated failures of the same component or subsystems must be upgraded before verification testing can be rescheduled. Rescheduling will be contingent on the submission and acceptance of evidence, obtained by the manufacturer through testing, that the cause of failure has been corrected. The Test Facility Manager will determine when significant repairs should be and have been made.

VEHICLE MODIFICATIONS/REPAIRS ON OR NEAR THE TEST FACILITY

a. Only those modifications or repairs that can be completed within 5 working days by the manufacturer or his designee will be allowed. If the repairs cannot be completed within this period, the vehicle must be removed from the test facility unless DOE programmatic requirements dictate that it is in the best interest of the Government that a waiver be granted by the Director of the Electric and Hybrid Vehicles Division or his designee.

* The manufacturer is responsible for notifying the DOE Director of the Electric and Hybrid Vehicle Division or his designee of all modifications to the verified production configuration.

b. All failures requiring repair, whether significant or insignificant, will be recorded by the Test Facility Manager or his designee. For all repairs the manufacturer must submit (to the Test Facility Manager) written explanation of the failure modes and the corrective action within 15 days after completion of corrective action. Failed components or subsystems must be replaced by an identical part except in those cases where the component or subsystem design is inadequate. In the latter case, the manufacturer may substitute a readily available component or system when the manufacturer can provide assurance of improved reliability and performance.

c. Three on-site repairs to correct a significant power-train failure are allowed. A fourth failure will invalidate the vehicle certification, and the Facility Manager will order the vehicle to be returned to the manufacturer unless DOE programmatic requirements dictate that a waiver be granted by the Director of the Electric and Hybrid Vehicles Division or his designee.

d. Subject to overriding priority considerations, testing will be resumed as soon as repairs are completed.

VEHICLES RETURNED TO THE MANUFACTURER BECAUSE OF FAILURE IN TEST

a. A letter invalidating the certification will be issued to the manufacturer and DOE will notify site operators of the invalidation. A report including the vehicle failures will be provided by DOE to members of the public requesting such a report. Vehicles that are part of the Market Demonstration Program (based on the manufacturer's self-certification) which fail the verification tests will have their certification invalidated until successful correction of the defects is completed. Future funding to site operators for the invalidated vehicle model will be suspended until corrections are completed.

b. A one-time voluntary withdrawal of a vehicle from test by a manufacturer to correct problems is allowed for a period not to exceed 60 days. The vehicle will be rescheduled for testing based on priorities at the time of resubmittal. No action will be taken to invalidate the certification during the voluntary withdrawal period unless there is a clear case of user safety involved or the manufacturer fails to offer the vehicle for test after 60 days.

c. Before a vehicle can be resubmitted for testing, the manufacturer must provide to the Director of the Electric and Hybrid Vehicles Division, or his designee, appropriate evidence that modifications and/or repairs have been made. The manufacturer must also provide substantiating test data to show that the vehicle can meet all DOE Performance Standards.

d. Repaired vehicles returned by the manufacturer may be required to undergo the complete series of verification tests regardless of the portion of testing completed prior to invalidation of certifcation. The Test Facility Manager with the approval of DOE will determine the necessity for such retesting.

GROUNDS FOR INVALIDATING CERTIFICATION

a. A vehicle will be returned to the manufacturer after four significant power-train failures or a single power-train failure that cannot be corrected, and its certification will be invalidated.

b. A vehicle that fails to meet applicable DOE Performance Standards will have its certification invalidated. (The standards include documentation and warranty provisions.)

c A vehicle that fails to comply with applicable DOT/NHTSA Safety Regulations will have its certification invalidated.

d. If a manufacturer fails to commit to and follow a reasonable schedule (defined in the following section) to provide a vehicle for testing when requested by DOE, the vehicle will have its certification invalidated.

SUMMARY OF RESPONSIBILITY OF MANUFACTURERS

Manufacturers must self-certify their production vehicles to participate in the DOE Market Demonstration Program. They must also commit to reasonable schedule to provide a vehicle for verification testing upon request from the DOE designated Test Facility Manager. If this delivery cannot be made within 60 days after receipt of such a request, the self-certification letter will be returned and the vehicle will be removed from the self-certified list.

Manufacturers must provide required and necessary information to document the vehicle configuration:

- Vehicle Summary Data Sheets.

- Operator's Manual and Service and Maintenance Manual including a parts list.

This information may be in draft form, but it must be complete enough to be useful should any mechanical or electrical difficulty develop in the vehicle.

The manufacturer will notify the Director of the Electric and Hybrid Vehicles Division or his designee of all modifications to previously verified production configurations within 30 days of the sale of such modified vehicles to DOE site operators. If it is requested, the manufacturer shall furnish the DOE Test Manager with technical information about each modification in sufficient detail to determine if reverification tests are needed.

For vehicles receiving an invalidation of certification, the manufacturer must provide to the Director of the Electric and Hybrid Vehicles Division appropriate evidence that modifications and/or repairs have been made and must also provide substantiating test data to show that the vehicle can meet all DOE Performance Standards prior to resubmittal of the vehicle for test. Following successful verification testing, vehicles already in DOE site operator fleets must be modified and/or repaired in the same manner as the vehicle successfully tested. A modification and/or repair schedule acceptable to the Director of the Electric and Hybrid Vehicles Division must be developed and followed by the manufacturer as a condition for validation of the manufacturers certification.

DOE NOTIFICATION DOCUMENTATION

DOE will notify manufacturers of actions taken during the verification testing process, including but not limited to:

- Receipt of self-certification.
- Notification of vehicle failure.
- Validation of invalidation of certification.
- Final Test Report.

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